THE

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PROLONGATION OF PATENTS.

ANOTHER master patent controlling the continuous current system of electrical distribution has expired, and the petition to the Judicial Committee of the Privy Council craving a prolongation has been dismissed. We refer to the Hopkinson three-wire patent. In the interests of the electrical industry it is well that patents covering fundamental and essential parts of distribution systems should come to an end—and with the expiry of this last one, the industry is free, with the exception of the bayonet holder for incandescent lamps, which, however, also soon expires, and the polyphase patents.

Prolongation of patents is granted if the petitioner proves three points.

1. The merit of the invention.

2. That every possible effort has been made to make the invention commercially successful.

3. That without any fault of his own the petitioner has been unable to reap a sufficient reward.

As a rule, the merit is easily proved, for the fact that the patent has been maintained for 14 years, and a prolongation is desired, shows that there is some merit in the invention.

On the second point, some well-known patentees would find it difficult to prove their case. One can easily call to mind instances where powerful companies have held patents for years merely as weapons of offence, and, when other inventors had perfected details never thought of by the original patentee, and the patent thereby become of some commercial value, an action is brought and a monopoly established for the few remaining years of the patent.

The patent which has just lapsed had its validity established only in 1892; for 10 years it was laid up like a sword in its scabbard. During this period, by means of public money and highly paid skilled engineers the invention was proved to have merit, and was made a commercial success, but it would have been difficult for the owners to prove that they had made every effort during the first eight years to comply with the necessary conditions.

If this had been done either by the patentee or assignees, why were no steps taken to impose royalties long before 1892, when 10 years of the grant had expired? Neither of the petitioners could say that they were unable to do so.

An able patentee may hold his patent for a favourable opportunity to sell out; he may wait ten years, but then he sells only four years' monopoly. It would be obviously unjust to the public to prolong the monopoly simply because an inventor decides to lock up his patent to suit his own convenience; but the case is very different where an inventor and a capitalist work together from the first to make a commercial success, and, failing, apply for prolongation to enable them to reap some profit.

In the case before us the invention was a proved success when it was bought up for the remainder of its life by the petitioning company. They knew how long it would run, and approximately what it would be worth. They were also aware, or ought to have been, that an action would require

to be fought to establish the validity of the claims. The sooner the second point we have set forth is taken to heart by those calculating on obtaining prolongations the better. It would never do to allow speculative capitalists to buy up good patents a year or two before expiry, and then to grant a prolongation on the plea that they had not had time to make sufficient profits.

The third point raises the question as to what is sufficient reward for the meritorious invention; this question, of course, is left to the Judicial Committee when no sale of the patent has been effected, but where the patent has been sold, the reward to the inventor is already fixed by the price he has accepted. He cannot, therefore, plead that he has not had sufficient return for his labour.

The purchaser who virtually becomes the patentee in law may have paid too much for the patent to enable him to recoup himself in the time left, but that is no reason why the public should suffer a continuance of his monopoly. The purchaser, again, may not make every effort to work the patent to a profit, or he may mismanage it, or, by any other means, fail to make profits in the time he has under the 14 years grant. But having bought the patent, knowing its value, and that it was granted for only 14 years, he has no claim whatever on these grounds for prolongation. The prolongation of patents is an excellent thing so long as it is for the benefit of patentees of meritorious inventions who have proved that points two and three apply to their case, but we do not think it right to grant prolongations in any cases where a purchaser of a patent applies for it for his own benefit alone.

Prolongations should be confined strictly to the inventor who has not made anything out of his patent, or to an inventor and a capitalist jointly, neither of whom has reaped a due reward; but we cannot admit the claims of a capitalist who has paid too much for a patent. The fact that he has not reaped the profits he calculated upon cannot justify any extension of the monopoly, besides, it would be somewhat difficult to find just what a capitalist who buys a patent would consider a "sufficient reward."

The decisions of the Judicial Committees have always taught purchasers of patents not to rely upon prolongations in calculating the price to be paid, and it is difficult to conceive of any business man doing so; it is therefore not to be wondered at that a purchaser seldom succeeds when petitioning for an extension of his monopoly.

Fair Game!

If Corporations have neither souls to be damned nor bodies to be kicked, it is, at any rate, a matter of common knowledge that they have purses to be dipped into, and the most rigidly high-minded man sometimes finds his conscience inclined to relax when, for instance, questions of compensation from a company or corporation arise for decision. Human frailty looks upon "getting the better" of a railway company as a pardonable offence; in fact, the general feeling too often appears to be "*Do* the company, as the company would like to *do* you"—a highly perverted version of the best maxim ever uttered. Some startling instances—in regard to tramway companies in America—of this regrettable tendency towards what is really blackmail are noted by the *Street Railway Journal* in its "Legal Comments," and they will bear a brief reference in our columns, having in view the possibility of accidents to street wayfarers arising in this country also in considerable number from the greater speed and frequency of tramcars when operated by electric energy. The chief trouble in the United States seems to be that not only the juries, but even the judges themselves deliberately follow a bias in favour of the public, irrespective of evidence that may show the fault of the accident in no way to lie at the company's door, but to be wholly that of the injured individual. It is hardly likely that the same difficulty will arise with us, at least to a serious extent. We are no great admirers of the average British jury, but it is, at any rate, *desirous* of dealing fairly with the parties concerned, whilst our judges are above even a whisper of reproach in this respect. There is, however, a difficulty to be found everywhere in compensation cases, and that is, that the general public (from whom juries are drawn) do not easily distinguish between the strict letter of the law and what they regard as "equity," that is, the average jury has an instinctive feeling that although a tramway company may not be in the least to blame in regard to any particular accident, yet it can well afford to pay, at least, *some* amount of damages to an individual—probably extremely poor—who has suffered through his or her own carelessness. Companies who defend actions for injury are usually looked upon as modern representatives of Shylock to be dealt with in the same way, that is, to have all the law they want, and a little "equity" besides. Hence a business-like management more often than not will attempt to settle such matters by compromise; and anyone who has seen a little of the interior working of railway and tramway companies will know well that such efforts are both common and usually successful. It would, however, make affairs run more smoothly for companies and public if the two aspects of these cases could be clearly separated, and decided in separate courts—one of law as to the facts, showing responsibility for the accident, and one of public opinion, as to the fairness of compensation to the injured person, all things being considered. Decisions of the latter court are, however, neither existent nor binding—to use an Irishism—so that, pending the millennium, we are still dependent upon the impartiality of judges and juries to settle these matters with mutual fairness when brought into court. In defending an action for damages, where no real blame can be proved, or even alleged, a company should not, however, be considered heartless because an unhappy sufferer would benefit by a favourable verdict from a sympathetic jury. The public work of companies operating railways and tramways is hard enough and difficult enough without this additional bugbear; and no one can assert that these companies are particularly desirous of causing injury to those from whom they should obtain support.

Gas Traction.

On another page we have placed the *pros* and *cons* of gas traction before our readers. Before this appears in print, the lists will have closed for the application for shares in the British Gas Traction Company, which is being floated for the sum of £250,000, to work the Lührig system in England, so there is the usual short time for criticism allowed, and people are rushed into these things nowadays without a chance of inquiry. So little seems to be now patentable, that we do not see why a steam engine should not be patented in combination with a dynamo. Tramcars are old, and so are gas engines, and there is certainly nothing novel in the idea of compressing gas into cylinders to be used on tramcars in gas engines, for the present writer invented the whole thing practically as it stands to-day over a dozen years ago, but did not believe it patentable; and lo! here in Mr. J. F. Moulton, Q.C., and a brother Q.C., both staking their hard-earned pennies in the Lührig patents. The artful part of this comes in publishing Mr. Moulton's letter, in which he says he cannot advise on the validity of the English patents, because he is a large shareholder. Not having advised, of course, no fee could pass, and all the same Mr. Moulton's declaration that he himself drew the patent is as good as a favourable opinion on its merits. Artful Gas Traction Syndicate!! But Mr. Wallace, Q.C., is more cautious; he also is a shareholder, and cannot offer an opinion, so he advises them to rely on Mr. Imray's opinion, and Mr. Imray's opinion is couched in that ambiguous halting and irrelevant style to which men are prone who do not wish to deeply commit themselves. It is also published that there will be no smell from the gas or oil. How the gas engine exhaust is to be made odourless is, however, not stated, and we feel qualms of doubt on this point. Even the spirituous scent from the light and innocuous petroleum carriage finds objectors, yet the scent is as nothing compared with the exhaust of a gas engine.

THE DAILY PRESS AND ITS TECHNICAL WRITERS.

We venture to think that some of our daily contemporaries would do well to occasionally employ special writers for special subjects, or else leave them alone. Quite recently this view has been particularly impressed upon us in connection with the death of Sir John Pender.

It might have been supposed that an obituary notice of Sir John would have been put into the hands of someone with a knowledge of matters telegraphic by that tower of strength, the daily press. In very few instances, however, does such appear to have been the case.

Again, our impression of the accuracy of the *Times* has been rudely shaken on several recent occasions, and in this instance particularly, for here the "leading journal" comes out worst of any. In its article with reference to the late Sir John Pender one learns that:—1. He was a Fellow of the Royal Society of *Engineers*. 2. That Glass, Elliot(t) & Co., and the Gutta-Percha Company were formed into (3) the *Cable* Construction and Maintenance Company.

Just as the *Star* and other half-penny prints possess their "young men," so we usually look upon the *Times* as having its highly respectable patriarchs, but here, we think, they must have put a "young 'un" on to the job.

The *Morning Post* obituary article of Sir John appears to have been written, or inspired, by the same hand, as precisely similar mistakes are to be found.

The *St. James's Gazette* gives a *réchauffé* of the *Times*, but goes one better by alluding to Sir John as "the distinguished electrician," a description which by no stretch of imagination could be said to apply; moreover, the "cable king" himself would never have pleaded guilty thereto.

The *Daily Telegraph* finds that Sir John Pender had just lately recovered from a long and painful illness at his town house in Harley Street, whereas he never lived there, but in Arlington Street, which may sound similar to some ears, though not to ours.

Amongst the morning papers the *Standard* was, perhaps, the best informed in its reference to Sir John; and the *Pall Mall Gazette* also had an excellent leader thereon. However, by far the most accurate and complete obituary was to be found in the *Globe*.

The most unpardonable and distasteful offence committed in the daily press is the invariable habit of all newspapers only to allude to the financial people connected with submarine cable enterprise: or, at any rate, to leave out those pioneer engineers or electricians who happen to be dead—maybe some years. This, though their *work* is supposed to be lasting. In some instances these pioneers have had to give way to men who acted in very subsidiary positions in the early pioneering work, but who happen to be still living.

Considering the large number of telegraph people who can do justice to such subjects, it is to be regretted that the daily papers do not more employ outside writers for the purpose. As it is, some articles have only the effect of divulging their general untrustworthiness to those who know; and of misleading the weekly papers which copy from them.

Oddly enough, both our electrical contemporaries proper have fallen into some of the same errors here alluded to. The *Electrician*, of all journals, should surely know how the late Sir George Elliot's name was spelt.

GAS-DRIVEN TRAMCARS.

It has always seemed to us that the claims of gas for motive power were but poorly represented. Totally unsuited as an illuminant, on the score of health and danger, gas ought to prove of great use in tramway work. So claim its friends, who argue that gas is so widespread and so easily obtained, and gives so high an efficiency when burned in a heat engine, that it ought to prove economical, and, if we are to take the figures derived at Dresden with gas at 40 pence per 1,000 feet, and at Dessau with gas at 35 pence, viz., 1·23d. and 0·9d. per car mile, it has already proved so, and the relative cost of traction in Germany, all inclusive, is given as 5½d. for horses, 14¼d. for electricity, and 3¼d. for gas, while at Croydon the figures, as given by Mr. Woodall, are 5d., 2½d. and less than 1d. respectively. The advantage possessed by gas is its portability. In the first place it is cheap to make, in the second it will travel to any point up or down hill, through cheap pipes, with very little driving power behind it. The consumption may be as low as 30 feet per car mile, and if compressed to 10 atmospheres a reservoir capacity of 30 feet will drive a car 10 miles, so that it is easy to carry sufficient gas for several miles run. The Lührig system has been at work for nearly two years in Dresden and Dessau, and the new tramway between Blackpool and Lytham has now been supplied with gas-driven cars. Blackpool seems to have the peculiar fortune as the scene of first trials of novel methods of tramcar driving.

The line when finished will be 8 miles in length. Under one of the seats is a long gas cylinder, under the other a two-cylinder engine with cylinders 7½ inches × 9¾ inches. The engine drives the axles through two sets of gears and clutches with chains, so that the car will run both ways at two speeds of 4 and 8½ miles per hour. The power is 15 horses, and the car weighs 7½ tons. The engine is so arranged that it runs at 260 revolutions when connected, and at only 80 when running idle. When idle, the oil is shut off also, and when on easy roads one cylinder has its gas supply cut off, so that a good deal of elasticity is possessed by the car. As the car holds 40 passengers, the expenditure of even 40 feet of gas per mile is not serious.

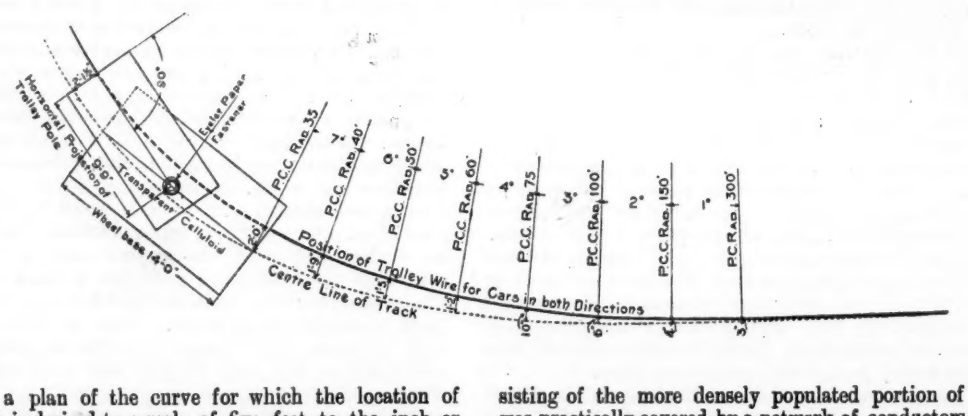
Jacket water is carried in tubes on the roof, and the waste heat ought to be available for warming purposes in winter. The only outward signs of the gas mechanism are the gas storage cylinders and the lower half of the fly-wheel casing, otherwise there is nothing to show that the car is not a horse car. According to the *Engineer*, the cost of the gas compressing plant for six cars is only £350, and even this is a portable plant. Any tramway can take a gas car, and the whole equipment of a line can be transferred to another line, all that is needed being a gas supply.

It is, of course, due to the fact that gas supply is an old and established industry that these advantages are secured. The question of cost would be seriously altered were it necessary to erect a gas works, but even this would be an easy matter for producer gas, which could very easily be arranged of a portable description. But the difficulty with producer gas would perhaps be in the storage or the compression. Its volume for an equal mileage would be, probably, four times that of lighting gas, so that it would need to be compressed to 600 lbs. pressure, or, say, to 300 lbs. in double the number of cylinders, and with increased pressure comes danger. In the Potteries, the Black Country, or the manufacturing districts of Lancashire and Yorkshire, where gas mains are everywhere, and there is no gap on any principal road in main continuity, the system cannot fail to be a potent rival of all other systems of car propulsion. Its limitations are evidently those of gas-carrying capacity, for, even if safe, high pressures mean more costly compression plant. The gas-driven car is thus clearly for use in thickly populated old-established districts. Even in this respect, however, it is open to its friends to say that gas mains are cheap, and could be laid more cheaply than electrical conductors along a country road, and in this manner cars could run between towns 50 miles apart, with four intermediate compressing stations, and only 40 miles of main for the central 10 miles could be covered without the main. Further, so long as there is a gas main to supply gas, there is no absolute need for a compressing station. The engine will draw its own gas supply from the stores, and with supply spigots at short intervals a car could take in a fresh supply at short intervals, and so bridge over a gap. In country work, too, a carefully laid small gas supply pipe of steel would supply ready compressed gas from a distant compressing station, and it should not be a difficult matter, even where this were not done, for each car to compress its own gas to moderate pressures, drawing it from the main. The system has very considerable possibilities, not the least of which is the small expense of trying it. So much, then, in its favour. Against gas are urged several disadvantages. The exhaust is excessively disagreeable. The mechanism of a gas motor is very much more complicated than that of an electric motor, especially for reversing. A very elaborate system of lubrication is necessary, and it is conceivable that the water supply might

give out unseen, and the engine bring up with the customary groan peculiar to gas engines. The range of speed is not equal to that possible with the series parallel method of control of electric cars, and no matter what may be urged in support of the possible safety of steel cylinders compressed to 150 lbs. gas pressure, the public always will put in objections to sitting over a cylinder of compressed gas. The public will stand being blown up, and will not flinch from being burned if occasion calls for it, but with the public it is always the case of "one at a time, please," and to be at once blown up and enveloped in flame, as would so easily happen if a gas cylinder were to rip, is too much to be risked. The combined system of trolley cars and accumulators, tried with success in Hanover and Dresden, also wipes out one of the advantages of the gas car that it can be used where the trolley is not allowed and the culvert is undesirable. We believe, however, that for a time the prevalence of gas mains and the initial expense of electrical mains, may give the gas motor car quite a large use. It will in many cases prove the pioneer of mechanical traction, and pave the way for electrically propelled cars, and if it does this it will have served a good purpose.

CORRECT LOCATION OF TROLLEY WIRE ON SPIRAL CURVES.

Writing in the *Street Railway Journal*, Mr. Chas. A. Alden says: The method of locating the trolley wire on curves, given in the June issue of the *Street Railway Journal*, is only applicable to the use of simple curves, while modern practice tends towards using a true spiral curve of considerable length for the ends of all curves. For this portion of the curve, perhaps 40 feet long or more, Mr. Foster's formula would not apply. The proper location can be easily found by the use of a template of the essential elements of the problem, *i.e.*, the wheel base and the horizontal projection of the trolley pole.



Having a plan of the curve for which the location of trolley wire is desired to a scale of five feet to the inch or larger, take a piece of thin transparent celluloid and cut it to the length of the wheel base (on the same scale as the plan) and mark with a sharp point a line for the centre line of the car and mark the centre of the wheel base. Then cut another piece a little longer than the horizontal projection of the trolley pole. Mark a line on this at right angles to one end and mark the length of the horizontal projection of the trolley pole from this end. Then join the two pieces at the centre of the wheel base and centre of the trolley base, by an eyelet paper binder, loosely enough so that they may turn with some little friction.

Then, placing the template upon the plan of the curve so that the wheel base coincides with the centre line of the curve and swinging the "trolley pole" until the square end is radial to the track curve, we can mark a point which will be approximately on the wire curve. Carrying this process through the spiral to the point where the offset becomes constant, we next sketch in the approximate location through the points just found. Going over this again, and making the "trolley pole" square with radial lines from this approximate location instead of those of the track curve, we can lay down the final location of the wire for cars to run in one direction. If cars are to run in both directions, the location should be found by taking an average of the curves located by the aid of the template.

In the instance shown in the sketch there is from 6 to 8 inches difference in the offsets for cars going in opposite directions.

Having plotted the wire curve on the plan, of course the offsets will be taken off by scale and used as circumstances may require.

This method can also be used for locating frogs over complicated switch work when the curves are compounded, in finding the proper position for the trolley wire in a car house door, and in other ways which will suggest themselves to the constructing engineer.

The time taken for the operation, having the plan and template in hand, should be trivial.

If the outer rail of the curve is elevated, the trolley wire should be set in towards the centre of the curve an additional amount equal to

$$\frac{\text{Elevation} \times \text{height of trolley wire above rail}}{\text{Gauge}}.$$

THE EFFECT OF THE ST. LOUIS STORM UPON OVERHEAD LINES.

The terrific storm which visited the city of St. Louis on May 27th caused very considerable damage to the various electrical undertakings. With characteristic impartiality the electric lighting, telephone, telegraph, tramway, messenger, fire alarm and police systems were affected. Nearly the whole of the conductors were overhead, and the area covered by the storm where it possessed sufficient violence to blow down wires and poles, is said to have been at least 10 square miles. The western half of the district, which is thinly populated and includes two large parks, contains only a comparatively small number of poles; but the eastern half consisting of the more densely populated portion of the town, was practically covered by a network of conductors of various kinds. It was in this latter section that the havoc was most severe, one lighting company alone losing no less than 1,000 poles, and it is estimated that the salvage from the wreck will fall short of 10 per cent. of the original cost. Although some hundreds of men have been employed in renewing the system, it is stated that several weeks will elapse before complete restoration has been effected, and, according to latest advices, some of the streets are still involved in total darkness at night. Concerning another company, it is said that the trunk line was demolished, "the mammoth poles snapping off like pipe stems." One of the undertakings, the St. Louis Electric Light and Power Company, is said to have sustained "comparatively light" damage, but it, nevertheless, lost the "smokestack of its power house" and several miles of wire and poles. Practically everything belonging to the Bell Company in East St. Louis was "swept away," most of its poles being broken in two. The St. Louis Fire Department lost about 100 miles of wire and 50 fire-alarm boxes, and of its 35 engine houses only three were left "in service," the circuits of the others having been

broken, and one house completely demolished. It is grimly recorded that the various messenger call companies "string the wires on house-tops, and therefore lost no poles." The telegraph systems were disabled for several days, and the tramcar companies, all of which with the exception of three, depend entirely upon electricity, suffered correspondingly. One power house was completely demolished, the ruins burying the machinery. It is related that "after six days' digging the débris was removed, and one of the dynamos found in fairly good working order. All trolley lines in the path of the storm were blown down wholly or in part. The poles for the trolley wires are all of iron. Some were snapped off and others blown down."

Such is a brief epitome of the havoc wrought by the short-lived hurricane, and the capital cost to the various electrical undertakings is said to be $500,000. Our New York namesake, in summing up the damage occasioned, remarks that "the only company whose wires were underground in the city was the Postal Telegraph Cable Company, and it was over their lines that prompt news of the storm and its devastating effects was sent to the outside world; all other wires in the city were strung overhead, and wherever the course of the storm was, there also was complete destruction. While such terrific storms are very unfrequent, yet we have here the most forcible example possible of the advantage of underground wire and cable systems."

From our point of view the argument in favour of underground work is almost unanswerable; the damage does not end with the destruction of the poles and wires, for as it has been recorded that the streets were crowded with people, and that very many were killed, it is very probable that many lives were sacrificed in the shower of poles, insulators, and wires, and that the death roll is correspondingly higher than it would otherwise have been. Those of our readers who have followed our record of events in America, can scarcely close their eyes to the fact that there is a rapidly growing conviction across the water that all wires and cables must be placed underground, and although we are rarely visited by such disastrous storms as that now under consideration, it seems to us that our engineers cannot too well consider the question before they adopt the overhead system in the various electric traction schemes which will sooner or later be undertaken in our towns and cities. No one, of course, dreams nowadays of overhead conductors for lighting purposes, for, even if for no other reason, it would be simply courting social trouble and turmoil if the light of our streets and thoroughfares were left to the mercy of a puff of wind. Our great danger, however, is not to be feared in the motion of the air alone, but lies rather in the accumulation of half-frozen snow upon the wires. If the poles are strong enough comparatively little damage need then ensue, as the wires would simply break down under the weight, and thereby relieve the poles. A good lesson in this direction was learned in England from the snowstorm of Christmas 1886, when one heavily wired but too lightly poled telegraph system was wrecked for many miles, and no less than three months were occupied in its re-establishment.

When we consider the enormous loss which the St. Louis electrical companies have suffered, not only as regards the actual destruction of plant, but also in loss of business and loss of confidence on the part of their customers, we become even more convinced that the advice which we have from time to time tendered with respect to overhead and underground lines is perfectly sound. In the case of thickly populated cities there can be no doubt that even from a purely financial point of view all telegraph, telephone and electric lighting wires should be placed underground. For electric traction purposes there are still strong arguments in favour of running the lines overhead, where such a course is permissible; and it must be remembered that such lines, being lower and more protected by buildings, are far less liable to destruction by storm than telegraph, telephone and lighting lines, which are run over the house-tops. In the case of very long lines, however, we are compelled to admit that if we take the financial side of the question alone into consideration, it is generally preferable to run overhead lines, and to take the risk of the havoc wrought by occasional storms. Only a government department having a monopoly can afford to sacrifice economy to efficiency and run such lines underground. But we again emphatically call attention to the necessity of constructing overhead lines in such a manner that not only shall the violence of a storm be resisted to the utmost extent, but that when the breakdown does occur the only portions of the system to suffer shall be those which can be most readily repaired.

In making good the ravages of the St. Louis storm by far the greater proportion of time and money must be expended in replacing the poles and other supports of the wires. Further, a pole, an arm, or an insulator, when broken is practically valueless, but copper wire by the aid of a few joints can be used again, and even if broken into short lengths will still fetch almost its original price. In other words an overhead line must be constructed in such a manner that the wires will first give way. In order to show how this fact is now becoming recognised in England we may quote from the paper read by Mr. Langdon before the Institution of Electrical Engineers in April last: "It is no exaggeration to say that to the more perfect manner of staying the telegraph lines of the present day, and to the employment of machine stranded staying wire, we are indebted for that greater immunity from heavy breakdown which we enjoy at the present time. It is, in cases of snow, falling under those conditions which cause it to cling to the wires, a question of strength of pole *versus* strength of wire. Needless to say it is preferable that the wires rather than the poles should suffer; and, as a rule, such is the *status* at which well-built telegraph lines of the present day have arrived." We perfectly agree with this opinion which only a few years since would have been looked upon as rank heresy. As the Electrical Review was the first to unhesitatingly advocate this method of construction, we may perhaps be pardoned for quoting from a series of articles which we published as long ago as 1891, setting forth various lessons to be learned from the effects of storms in England; lessons which we think could still be studied by electric lighting and power transmission engineers with advantage. "The greatest trouble and inconvenience was caused by the necessity for renewing the poles, which had to be transported long distances, and then to be properly set in position. Most of this would have been avoided had the lines been constructed on the basis that the strength of the pole should be greater than the strength of the wires supported by it, which means simply that the wires should all give way before any damage is done to the pole . . . . . An ideal telegraph line would be one in which the poles are of ample size and frequency, deeply set, provided liberally with stays, and maintained in the highest state of efficiency. In fact, no effort should be spared to enable the poles to withstand the most sudden and the heaviest strains likely to be brought to bear upon them, while the wires should be so proportioned that they will give way just before the poles during storms of phenomenal violence." It is interesting to compare this opinion with the experience obtained by Mr. Langdon.

In conclusion, we may say that we heartily sympathise with our St. Louis brethren in their difficulties, but we cannot refrain from once more pointing out that many electrical engineers simply court disaster by running wires overhead where it is more economical as well as more expedient to place them underground, and by neglecting the lessons which others have learnt at great cost with regard to overhead construction, where such is advisable.

NEWSPAPER TECHNICS.

We often in these columns notice the struggles of the non-technical papers to make plain to their readers what they do not themselves understand.

Very often these attempts are no more than matters for a jest, but the article, "Electricity from Rubbish" in the *Morning Post* of Tuesday last week passes a joke.

The representative of the *Morning Post* visited recently the St. Pancras Destructor and Electric Light Station, and from what he saw and what he was told, with the help of the usual historical retrospect and a copious vocabulary, spun out an article nearly a column in length, headed "Electricity from Rubbish," and ending up thus:—

Various alterations are in progress, however, and until these are completed it is impossible to say definitely whether the contents of

our dustbins can be turned into light without considerable assistance from good coal. Certainly the average engine-driver would look troubled if requested to raise steam with such unpromising fuel. But here, as already explained, the rubbish is burnt under favourable conditions with every help that science can devise. It is a most tempting programme which the St. Pancras Vestry have set before the rateyayers—the transformation of unclean and evil-smelling waste into pure radiance, and even if they succeed in only partially carrying it out they will earn the gratitude of the community at large, and will have many sincere flatterers in the form of imitators.

The special committee on electric lighting of the Mile End Vestry, also recently visited the works and concisely reported :—

At St. Pancras your committee were much assisted by the resident engineer, who informed them that special apparatus had been laid down for the purpose of producing steam from the burning of house refuse, but the same had not proved successful. Practically, the whole of the work had to be accomplished by the use of coal.

The latter, in two sentences, writes the grim epitaph of the destructor as a possible source of electric light. The former, in nearly a column, gives the general idea of an experiment, the issue of which is still in doubt ; of the possibility of the destructor as "the transformer of unclean and evil-smelling waste into pure radiance."

There is no doubt as to which is the correct report, considering that one is on the authority of the resident engineer, and the other on the authority of an anonymous journalist.

The wide difference between the engineering fact of utter failure, and the journalistic fiction of success, still elusive but not unattainable, shows again, as we have always contended, that the ordinary journalist or reporter is not competent to report on technical matters, and shows, also, how easily his ignorance may be exploited so as to obtain the weight of the authority of a great journal for an opinion which really represents the judgment of one John Smith—a man very ill qualified to judge—upon the partial presentation of facts, which however presented, he would be incompetent to weigh.

If we did not regard the advocacy of the destructor, as an appreciable factor in electric lighting, to be so hopelessly discredited that

> Not all the king's horses, and all the king's men,
> Could ever put Humpty Dumpty together again,

we should be inclined to consider the article as the beginning of an attempt to carry on in the non-technical journals that campaign against the pockets of the municipalities and the credit of borough and electrical engineers, which must, perforce, be abandoned in the technical journals of the trade.

As it is we notice it only to enforce again our old contention : if the daily papers in their character as omniscient purveyors of general information wish to include electrical engineering as one of their subjects, let them in common decency see that the subject is in the hands of an electrical engineer—let the articles be less flowery and more accurate, let there be less padding and more facts.

If the editor of the *Morning Post* can indulge in the luxury of a ten days' memory, he may put the whole thing straight by a brief note to the effect that in the title of the article the words "Electricity from" are to be omitted, leaving for title and comment the one word "Rubbish."

TRACTION DIAGRAMS.

By THOMAS TOMLINSON, B.E.

(*Continued from page* 73.)

Theoretically, in a double run, the effect of grades is nothing, the positive values in one run becoming negative in the run in the reverse direction, and *vice versa;* practically this is never quite so, but is nearly true when no grade of the line exceeds the grade down which the car will run without acceleration, *i.e.*, that for which $p = 2{,}240 \tan \theta$.

This limit will lie somewhere about a grade of 1 in 100, or 1 per cent., as in American practice it is called. The reason for this is that you cannot, in electrical traction, as we know it, utilise the value of down grades above this, what we may call critical value, unless to a very limited extent; you can't systematically rush your grades so as to take the full value out of them in acceleration, for fear of the Board of Trade, and if you can't do it systematically, it won't affect your schedule time, and as the essence of a good tramway service is cars at equal intervals, unless now and again to make up time, you can't get out of grades much above 1 in 100 down hill, what you have to put into them uphill.

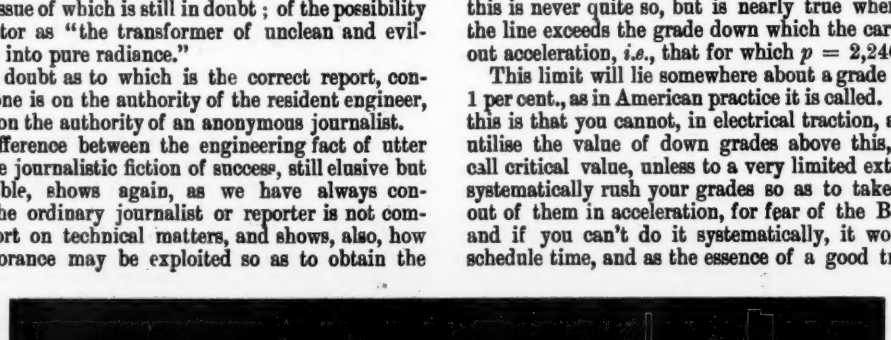


Fig. 3.

On the supposition of no acceleration down hill (we will make allowance for this afterwards), and a supposed value of p of 25 lbs. per ton, got from the particular run we are supposed to be considering, we can estimate the loss due to excessive grades, and show, also, the drawbar pull due to the combined effects of gravity and friction.

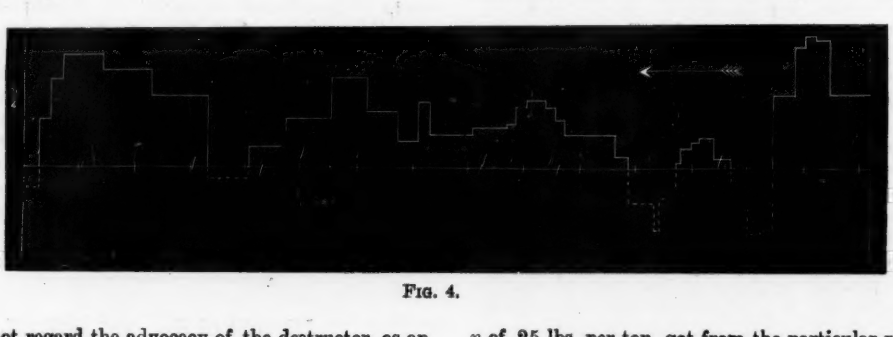


Fig. 4.

Draw the dotted line, A B, below the scale line, at a distance representing 25 lbs., and draw the dotted line, C D, above the scale line at the same distance. Then the complete diagram of drawbar pull, due to friction and grade combined, for a run from left to right is represented by all of the diagram of drawbar pull for grade only above the line, A B, and the lost value of down grades by all below the line, A B; and for a run from right to left is represented by all of the diagram below the line, C D, and the lost value of down grades by all above the line, C D.

The resulting diagrams are shown in figs. 3 and 4, in which,

in each case, the drawbar pull is plotted above the base line. The area shown below the base line in each case represents the foot-pounds lost on the run through unutilised down grades.

From the diagrams, the actual mean drawbar pulls for a journey in each direction can be found, and so the mean drawbar pull for the double journey, and also the mean drawbar pulls wasted. The resulting figures are :—

For a run left to right:

Mean drawbar pull ... ... = 25 + 0·8 lb.
Waste equivalent to mean drawbar pull of 12·2 lbs.

For a run from right to left:

Mean drawbar pull = 25 + 19 lbs.
Waste equivalent to mean drawbar pull of 7·7 lbs.

Therefore:

Mean drawbar pull for a double run = 25 + 10 = 35 lbs.

i.e., the mean drawbar pull is in this case increased by the grading 40 per cent. above what it would be on a level, or nearly level, line.

Or, the possible efficiency of transportation is, under the given conditions, only 70 per cent.

It will be noted that the sum of the mean drawbar pulls, "equivalent to waste" on excessive grades, is equal to the sum of the extra draw-bar pulls in both directions 12·2 + 7·7 = 19 + 0·8 (practically).

This can be readily shown to be universally true, and to find graphically the added mean draw-bar pull due to grades, we have only to draw the lines, A B, and C D (fig. 2), where L A = L D = ascertained value of p, and to compute the sum of the areas of the figures, bounded by the traction diagram as due to grades, lying outside the figure A B C D, and thence deduce the mean equivalent drawbar pull equivalent to waste, which added to the ascertained drawbar pull on level, gives the actual mean drawbar pull for the double journey.

It is to be noted that the less is the value of p, *i.e.*, the better are the conditions of line, the greater proportionately is the mean drawbar pull per ton increased by grades, or the greater is the loss due to excessive grades.

Leaving for future consideration the effect of grades upon central station economy, let us go on with the consideration of the theoretical traction diagram, adding now the factor of varying speed and stops and starts.

(To be continued.)

ON ALTERNATING CURRENT-RUSHES IN CONDENSERS.

By BERNARD P. SCATTERGOOD, M.A., Oxon.

(*Continued from page* 71.)

11. Initially we suppose the stop-cocks, C, D and F, all closed, and the piston in the middle position. The pump is now put in action by moving the piston up or down in the cylinder. To fix our ideas, we may suppose it moved *down*. The air in the upper part of E is thus rarefied, and in the lower part compressed, corresponding to the setting up of a difference of potential at the terminals of the dynamo. If the limbs of the U-tube are now connected to the pump by opening the stop cocks, C and D, a current of air passes along the pipes, the velocity of the air flow representing, in the electrical analogue, the strength of the charging current. The effect of the passage of air *out of* A, and *into* B, is to raise the level of the liquid in the former, and to depress it in the latter, precisely as the effect of passing an electrical current into a condenser is to establish a difference of potential between the condenser plates. And it is to be noticed that in the hydraulic model, as in the electrical arrangement, this difference of level can be brought about in either of two ways. The difference of air pressure in the two limbs of the tube can be produced either very gradually, by opening the stop-cocks, C and D, to a very small extent, so as to offer a considerable frictional resistance to the passage of the air; or suddenly, the cocks being thrown wide open by a very rapid movement. (It can never be produced quite instantaneously, owing to the inertia of the liquid in the U-tube; quite similarly, an electric current cannot be established instantaneously in a circuit which contains self-induction.) Electrically, we may say that the condenser may be charged either through a high resistance (small aperture in the stop-cock) or through a low resistance (full aperture). In the former case, the ultimate difference of potential of the condenser plates and difference of level of liquid in the U-tube, will each be attained gradually, and by a perfectly "dead beat" movement. But if the orifice of the stop-cock be large, the air will rush through with violence, the liquid in the limb, B, of the tube will fall suddenly to a level which is, owing to its momentum, lower than that corresponding to its position of final equilibrium, rising, of course, in A, to a height correspondingly greater; and equilibrium will only be established after a series of gradually decreasing oscillations. *Mutatis mutandis*, we have here an accurate picture of what takes place when the condenser is charged through a low resistance. Immediately after the charging circuit is closed, a heavy current passes into the condenser in one direction, charging its plates for an instant to a potential difference higher than that of the charging source; and the final potential difference is only reached after a series of rapid oscillations.

12. In this case, that, namely, of the oscillatory *charging* of a condenser, it appears that there is not necessarily a reversal of direction of the charging current, but only a fluctuation in its strength. When, however, oscillations occur at discharge, there is always a reversal of sign both of the potential difference of the condenser plates and also of the current in the discharge circuit. In our hydraulic model, the discharge is effected by closing the stop-cocks, C and D, thus cutting off all connection between the U-tube and the pump, and then opening the cock, F. As in the former case, if this is opened to a very slight extent, the flow of air is sluggish and its velocity decreases gradually to zero, without changing sign, and the equalisation of level of the liquid in the U-tubes is also effected in the same dead-beat manner. Under similar conditions in the electrical circuit, those, namely, of high resistance, the current of discharge is small and unidirectional. On the other hand, if the orifice of F be large, and the cock be opened to its full extent, the flow of air in the pipes is violent, and the effect of the momentum of the liquid in the U-tube is not merely to make the velocity of the air current in the pipes fluctuate in value, but to alternate in sign, the direction of the flow changing at equal intervals of time, while the maximum velocity reached in each successive oscillation grows gradually smaller, until entirely damped out of existence by the frictional resistance of the walls of the pipes, and of the particles of air amongst themselves. Electrically, the current of discharge is an alternating current, large at first, and gradually decreasing to zero; the potential difference of the condenser plates undergoing corresponding variation. It will be seen that as, in our hydraulic model, oscillations are or are not produced according to the relation which exists between the density of the liquid employed, the sectional area of the limbs of the U-tube, and the frictional resistance in the connecting pipes and stop-cocks, so electrically, the occurrence or non-occurrence of oscillations when a condenser is charged or discharged depends on the relation between the self-induction, capacity and resistance of the circuit. The analogy is thus very complete.

13. The reader can easily think out for himself a quite similar analogy applicable to the case which more immediately concerns us, namely, the charge and discharge of a condenser through a spark-gap by means of an alternating current. In this case, the alternations of the charging electromotive force are imitated very exactly by a reciprocating movement given to the piston of the pump, E. (Indeed, we have only to imagine that the piston rod is actuated by a uniformly rotating crank through the medium of a connecting rod of infinite length, to get a true sine-curve variation of pressure.) The spark-gap which breaks down under a certain pressure is represented in the hydraulic model by automatic valves at C and D (fig. 3), each of which opens either way, when the difference of air pressure on its two faces attains a certain value, closing again when equilibrium of pressure is established.

It will be easily seen that if the requisite conditions exist as to the size of aperture of the valve and frictional resist-

ance of the connecting pipes, oscillations will be set up at every stroke of the piston.

14. It would have been interesting to have used a revolving mirror for the purpose of analysing the sparks which passed at the gap in the experiment of Sec. 2, but I had not the necessary facilities for doing this. As before remarked, a rapid movement of the eyes suffices to analyse the sparks and show the normal alternations of current; but it was hardly to be expected that this rough-and-ready method would show any traces of the additional very rapid alternations which I assume to be superimposed upon the former.

15. In order to make actual measurements of the increase of current shown by the lamp under the conditions indicated in Sec. 2, I connected a Siemens dynamometer (D, fig. 4)* in series with the lamp, condenser, and spark-gap, and inserted two Kelvin electrostatic voltmeters, the one, V_0, a low pressure instrument reading up to 200 volts, across the terminals of the lamp, and the other, V, a high tension voltmeter across the 2,000-volt mains.

With the gap, P, short-circuited, it was found that a pressure of 2,000 volts on the mains, at a frequency of 83 ~ sent about ·17 ampere through the circuit, the deflection of the dynamometer being 65°; the pressure at the lamp was too low to read on the multicellular voltmeter, V_0, but would be, judging by the appearance of the filament, which glowed faintly, about the same as before, say, 30 volts. With the gap very slightly open, the dynamometer deflection increased a little, and the brightness of the lamp increased also to a corresponding degree. When, however, the gap was opened as far as it could be without breaking the arc, the lamp, L_0, glowed at from 110 to 120 volts, as estimated by the eye; voltmeter V_0 showed about 130 volts, voltmeter V remained as before at 2,000, and the deflection on the dynamometer actually *fell* to 5°, indicating ·05 ampere in the circuit. That is to say, on the normal (non-sparking) circuit a dissipation of energy at the rate of 30 × ·17, or, say, 5 watts, produced an amount of light equivalent to a very small fraction of a candle; while on the sparking circuit, energy dissipated apparently at the rate of 120 × ·05, or 6 watts, produced a light equivalent certainly to not less than 20 candles.

16. Now, a light of 20 candles produced in a glow lamp at the expenditure of 6 watts is clearly a result much too good to be true. Equally clearly, if, in a practically inductionless circuit, volts multiplied by amperes no longer give real watts, but an apparent watt-consumption actually less than the real power used—that is, if the lamp under these conditions has a power factor *greater* than unity—either our ideas of electrical quantities need to be revised, or the instruments are reading incorrectly. *A priori*, the latter supposition would seem more likely. In this case, either the dynamometer, or the voltmeter, or both may be at fault. If the former, two possibilities suggest themselves:

(*a*) That the insulation of the dynamometer coils has broken down, with the result that some of the turns have become short-circuited.

(*b*) That the low reading of the dynamometer is due to some force acting on the coils, external to the coils themselves.

17. With regard to the first hypothesis, that of a breakdown of the insulation, it may be noted that I used several dynamometers, all of which showed the apparent decrease of current; but in none of them was I able to detect, either by bridge or high tension tests, any indication of a failure of insulation. Moreover, roughly speaking, the minimum current indicated by the different dynamometers employed (which were all of the same type) was the same in each case; and it is difficult to imagine that in every instrument used, the same number of coils could have been short-circuited. Abandoning, then, the theory of breakdown of insulation, there remains the hypothesis that the indications of the dynamometer are disturbed by outside influences.

18. Eddy currents in the supporting pillars of the instrument appeared to be a possible explanation; but further experiments seemed advisable, in order to ascertain if a similar effect was produced on current measuring instruments of a different type from that of the Siemens dynamometer. I therefore repeated the experiment of Sec. 15 with a sensitive electro-magnetic ammeter in circuit, provided with a light movable iron core, and reading from ·05 up to 1 ampere; the Siemens dynamometer previously used was placed in series with this ammeter.

The frequency of the current in this experiment was about 160 ~. The results were as follows:—

1. Gap short-circuited	...	dynamometer	·22 amperes.
		ammeter	·24 amperes.
		lamp about	35 volts.
2. Short spark	... ...	dynamometer	·24 amperes.
		ammeter	·27 amperes.
		lamp	45 volts.
3. Long spark	... ...	dynamometer	·13 amperes.
		ammeter	·25 amperes.
		lamp	75 volts.

Thus the iron-cored ammeter appeared to behave in the same way as the dynamometer in the previous experiment; that is to say, for a short spark the current indicated was slightly higher, and the voltage on the lamp increased correspondingly, while with a long spark the current indicated fell, while the voltage on the lamp increased considerably. The current as indicated by the ammeter, however, never fell to a value *less* than that which it had when the gap was short-circuited, while the indication of the dynamometer, on the other hand, fell to a value considerably less than the original reading. It seemed, then, as though the same cause were acting in the two cases, but to a greater extent in one than in the other; and as it is impossible that both instruments should be right, the probability is that both were wrong. I have already indicated as the most probable explanation of the effects noticed, the existence in the circuit of electromotive forces of high frequency, and the magnitude of the effects produced on the current instruments, seemed to favour this idea. For the disturbances appeared to demand the presence of induced currents somewhere in the neighbourhood of the coils, and it was difficult to see how such induced currents circulating in the supports of the dynamometer, or in the metal cases of the ammeters used could attain a sufficiently high value to produce the effects observed, except on the hypothesis of great rapidity of alternation of the current in the coils.

It would be instructive to repeat these experiments with a dynamometer constructed entirely with wooden or non-metallic framework and supports, in which eddy currents would not be produced.

(*To be continued.*)

* Page 70 *ante*.

THE VIBRATIONS OF ENGINE FOUNDATIONS.

By JAMES WHITCHER, A.Inst.E.E.

(*Concluded from page* 69.)

In two cylinder engines with cranks opposite (as at Manchester Square), these secondary components coincide and assist each other. Therefore, although the pair of primaries balance, there still remains an unbalanced momentum equal to one-fourth of one of the former, and alternating twice as rapidly. The latter feature is very notable, in that it doubles the probability of several of such engines, either synchronising or balancing, in their oscillating efforts on the foundations. There are two points in a revolution at which engines may come into accord in this respect; whereas, in effects due to the primary components, they can only agree at one.

Single crank engines are seldom used as the main engines of central station; a combination of some sort is the almost invariable practice. Thus it generally happens that the reciprocating momenta of the sets of moving parts resolve into couples or oscillating moments about some centre. Often the resolution is partial only, so that there co-exists in the engine both unbalanced reciprocation and couples. For instance, in a double engine with cranks opposite, want of balance will be manifested in two ways. The one is the simple reciprocating effort, due to the two secondary component momenta, which coincide as already discussed. The other is an oscillating couple, in the plane of the centre lines of cylinders, due to the moments of the primary components about a centre midway between the lines of motion.

To save burdening the present article with a more detailed analysis, it may simply be stated that in any type of the common side-by-side engine, the unbalanced forces exist in

forms which can be resolved into some or other of four simpler forms, *i.e.*, a primary reciprocation and couple, and a secondary reciprocation and couple. There may also occur unbalanced circular momenta or circular momenta couples; but it is improbable that these will be present in any significant amount. The tilting effort mentioned above, due to the centre of gravity of foundations not being in line with the oscillating force, is a primary or secondary couple, as the case may be.

We have ascertained that a reciprocating movement of the foundations may be isolated when directed horizontally, but not otherwise. As regards the angular oscillation produced by the couples, it is possible to oscillate it in both directions. For the effect of such a couple upon the foundation block is to oscillate it, if free, about the centre of gravity of the whole mass, through an angle related to the angular swing of the couple, as the reciprocating mass is to the remaining portion of the total mass.

Then, if this angular movement be horizontal, by mounting the block on balls or the equivalent, leaving the sides free, complete isolation is secured, as well as regards angular as linear oscillations. Also if the movements be vertical, they can be isolated by rounding the bottom of the block to a curve having the C.G. as centre, and mounting it on rollers, or the equivalent, as before. By this means the block is given freedom to rock over the necessary angle.

A condition of this kind would be difficult to realise in a practical way, though possibly a deep layer of sand would give sufficient freedom. The transmission of vibration here depends upon the resistance to shear of the supporting earth in surfaces concentric with the axis of oscillation. The chief tendency of the motion apparently would be to propagate surface waves of length about equal to twice that of the block in the plane of motion, and possibly such waves would be too short and feeble appreciably to disturb the heavy masses of buildings. But this is conjectural.

What is more important to observe is, that the movements are capable of isolation; and, further, that they are of a nature to loosen the foundations from the surroundings and keep them free therefrom. This is also the case with horizontal oscillations, the earth becoming rammed clear of the sides and loosened beneath. Therefore, except when the subsoil is sodden with water, there is reasonable chance of all horizontal and angular oscillations being practically confined to the foundations.

With vertical up and down movements the case is very different; the whole force of each stroke is spent on the supporting earth, and must be dissipated somewhere. Nine times out of ten, perhaps, the conditions may be favourable for its harmless absorption, but, given a spongy water-laden soil, it is not surprising to find it manifesting itself in short surface waves, which give a decidedly uncomfortable vibration to the upper storeys of a house under which they pass.

A general conclusion may be drawn from the foregoing, that engine builders should at least be careful to balance all vertical momenta. Yet a common practice in horizontal engines is to introduce a vertical momentum in order to eliminate the horizontal. This is done in the so-called balancing of the moving parts by a counterweight on the crank disc or fly-wheel. The motion of the weight has, of course, equal horizontal and vertical components: the former balances with that of the reciprocating parts, while the latter remains uncompensated. This sort of "balance" is worse than none at all.

However, when vertical engines are thus treated, the unbalanced vertical momenta are replaced by horizontal momenta, which is a decided advantage. Unfortunately, the secondary components are not affected thereby, for to effect the same conversion with these, a weight revolving at twice the speed of shaft would be requisite.

The effects of one engine may be too insignificant to notice; but when there are several, there is always the possibility of their vibratory efforts synchronising. If all of one speed the chances are practically two to one in favour of the combined efforts being greater than one-half the maximum possible effect when all are in synchronism. For any pair of engines, if only one-third removed from the position in which they balanee, have a resultant effect equal to the maximum effect of one; and, of course, it is twice more probable their relative positions will be outside these limits than within. It is a very noteworthy fact this doubling of the chances in favour of vibration.

High-speed engines will, of course, come more often into synchronism than slow speed. If the engines be of different speeds, there will be constantly recurring periods of vibration alternating with periods of quiet. For the same reason as above, the period during which the vibratory effects are above the mean will be double that during which they are below.

In stations with equal size units driving alternators in parallel, the existence or non-existence of vibration during a run depends much upon the accident of starting. But where the units are unequal, or with continuous current plant in which there is no influence to keep the units in step; there is no such dependency on chance.

Finally, a note as to the frequency of vibration. One is apt to conclude that there would be less trouble from vibration with low speed engines than with high. This does not follow; for although in the latter case the vibrations are more rapid, they are also of proportionately smaller amplitude. Now, it is reasonable to assume that the nervous victim would not discover much relief in being shaken only once per second in place of ten times. And since the former is the more violent, he is more likely to detect it than the latter. Wherefrom it would seem that, given the same piston speed, high speed engines are preferable from this point of view.

ACCUMULATOR TRACTION.

Our esteemed contemporary, the *Electrical Engineer*, publishes an account, in the form of an interview with Mr. Ross, of Vienna, of a new development of accumulator traction which has a *prima facie* call for consideration. It has reference to the working of a system of urban and suburban lines by the trolley system as regards the latter, and by accumulators as regards the former, where, perhaps, a trolley wire would be inadmissible, and it appears to be identical with that proposed for London by Mr. R. D. Kenny in our issue of June 19th. The system appears to combine the good points of both systems with an absence of their disadvantages to a very considerable extent. The urban portion of any system of tramways is usually small, so far at least as the trolley wire is inadmissible. Each car, therefore, carries a small accumulator, which is in parallel with the motors. When a car is starting, the excess current is momentarily supplied by the battery. When the car is moving steadily it is drawing more than enough current from the wire, and the excess is stored in the accumulator. Arrived at the city where the trolley wire ceases, the accumulator takes on all the work, and is sufficient to bring the car back to the trolley wire, or we may suppose in case of failure there would remain the possibility of re-charging it from a buried conductor at the city terminus sufficiently to take it back to supply. Clearly such a system of working must tend to average the load on the central station, and to reduce the Alpine sharpness of the peaks to a closer resemblance to a more denuded contour.

At Hanover, where 35 cars are being regularly run on this system, these effects are produced; coal is saved, and the whole working of the supply station is eased. This is necessarily more marked in smaller stations where there is not so great a number of cars to ensure an average demand on the station.

Apart from the possibility that the final results may yet be found more costly by reason of accumulator expenses, there remains the fact that the choice of the system may be that of Hobson, as at Dresden, where the municipal authority forbids the trolley in certain streets, and specifies what form of conduit must be employed. Such streets are bridged, so to speak, by the combined system. There are two rival companies in Dresden, and for a few hundred yards they coincide. The accumulator system enables one company to use those lines without taking current from its rival's wire. The accumulators are being so treated as to ensure duration, being charged and discharged at short intervals, but no figures are yet available as to cost or relative cost. It may be inferred, however, that if accumulator traction has been so nearly a success as to be still used to a considerable extent, the com-

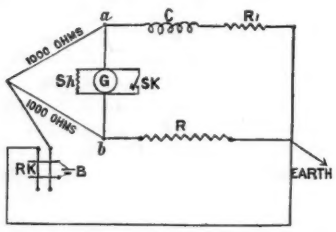
bined system, which needs a small accumulator only, and has a much more steady station load than the pure trolley system, stands a good chance of showing results of a very favourable nature. The increasing competition of gas-driven cars should at least prove an incentive to giving the system a trial.

INDUCTANCE AS A NEGATIVE CAPACITY IN SUBMARINE CABLES.

By A. DAVIDSON.

The following experiments, to exhibit the value of inductance as a negative capacity, were made on a length of submarine cable of modern type, armoured with steel wires and coiled in an iron tank. This piece of cable gave a circuit possessing inductance, capacity, and resistance. By a suitable arrangement, either capacity or inductance could be made to predominate. It is hoped that the experiments will be of interest on account of the commercial value of a "distortionless" cable.

The arrangement used is shown in fig. 1. The cable was inserted in one arm of a Wheatstone bridge, together with an adjustable resistance, R_1. It was then balanced for steady

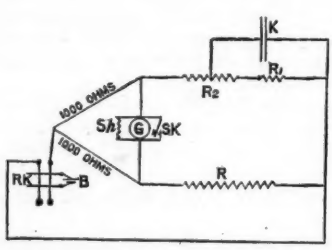


R, K, reversing key; B, battery (20 cells Leel.); G, galvanometer, 30,000 ohms, Thomson; *Sh*, galvanometer shunt, $\frac{1}{1000}$th throughout experiments; S, K, short-circuiting key; R, resistance box; C, 54 N. miles cable; C, R, = 157 ohms Cap = 18·9 mfs.; R, adjustable non-inductive resistance.

Fig. 1.

C_1 R_2 with $R_1 = 0$. The galvanometer short-circuit key was then left open and the swing, on depressing the battery key, observed. R_1 was then increased, a steady balance again taken, and the new movement noted. Table I. gives the value obtained.

When inductance prevails in the cable circuit the potential at *a* lags behind that at *b*. The result is a swing on the galvanometer. Owing to the great inductance of the coiled



R_2, non inductive resistance equal to C, R, of cable; K, 20 mfs. connected to the middle of R_2. The other parts are the same as in fig. 1.

Fig. 2.

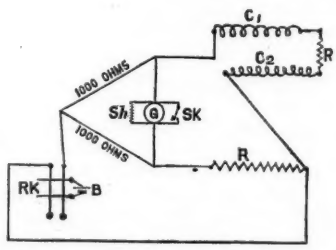
cable, quite an appreciable time elapses before the potential at *a* equals the potential at *b*, and the spot drifts back very sluggishly to zero. When capacity prevails, the potential at *a* leads the potential at *b*, giving a swing in the opposite direction to that observed when inductance prevails. This swing is quite sharp. At certain times (R_1 = from 700 to 1,300 ohms), it could be observed riding over the inductance swing; first, a sharp swing to the right, followed by a slower swing to the left, then a drift to zero. Both swings are given in Table I. This overlapping was the principal difficulty met with in taking these observations. It was, of

Table I.

R_1.	Swing.
0	... ... 680 divisions left.
100	... ... 450 " "
200	... ... 340 " "
300	... ... 260 " "
400	... ... 210 " "
500	... ... 170 " "
600	... ... 145 " "
700	8 divisions right then 125 " "
800	10 " " " 120 " "
900	15 " " " 100 " "
1,000	20 " " " 90 " "
1,100	23 " " " 80 " "
1,200	25 " " " 78 " "
1,300	25 " " "
1,400	30 " " "
1,500	31 " " "
1,600	35 " " "
1,700	38 " " "
1,800	40 " " "
1,900	44 " " "
2,000	47 " " "
9,000	92 " " "
50,000	110 " " "

course, essential to use an "earth," as shown in fig. 1, in order to bring the full capacity into play. When "earth" is not used, the capacity effect did not become apparent, even when R_1 was very large.

To separate the inductance from the capacity effect, the "earth" connection was thrown off, and a series of readings taken. These are entered under "Inductance Swing" in Table II. Experiment showed that with $R_1 = 50{,}000$ ohms, the capacity between the legs of the cable loop was not in evidence. These readings may, therefore, be taken as due to inductance.



C_1 = 65 N. miles of cable; C, R, = 600 ohms; Cap. = 22 mfs.; C_2 = 54 N. miles of cable; C, R, = 140 ohms; Cap. = 18·9 mfs.; R_1 = adjustable non-inductive resistance; other parts as in fig. 1.

Fig. 3.

An artificial circuit was then made up, as shown in fig. 2, with resistance and capacity only, to represent the cable. The capacity was lumped at the centre of the circuit for convenience, but the error due to this is probably slight. The readings with this arrangement are tabulated in Table II.,

Table II.

R_1.	Inductance Swing.	Capacity Swing.
0.	680 divisions left.	2 divisions right.
100	450 " "	10 " "
200	330 " "	15 " "
300	265 " "	21 " "
400	200 " "	26 " "
500	175 " "	32 " "
600	145 " "	37 " "
700	125 " "	41 " "
800	105 " "	44 " "
900	92 " "	47 " "
1,000	81 " "	50 " "
1,100		54 " "
1,200		56 " "
1,300		58 " "
1,400		60 " "
1,500	50 " "	62 " "

under "Capacity Swing." Comparison with Table I. shows that with R_1 = about 1,300 ohms, the inductance and capacity swings are approximately equal but opposite in both experiments.

To bring the capacity between the legs of a metallic loop into evidence, the arrangement shown in fig. 3 was used. Two lengths of cable were used, and R_1 inserted between them. Unfortunately, the lengths were of different types, so that the loop was not a symmetrical one electrically. Still the results, shown in Table III., are interesting, as displaying a method which may possibly be useful in determining the

TABLE III.

R_1.	Swing.
0	185 divisions left.
100	160 " "
200	135 " "
300	120 " "
400	105 " "
500	95 " "
600	85 " "
700	77 " "
800	70 " "
900	65 " "
1,000	60 " "
3,000	25 " right.
4,000	32 " "
5,000	37 " "

effective capacity of a metallic loop, an important quantity in telephone engineering.

These eperiments can only claim to be of a qualitative value. As such, they show that inductance does tend to nullify a distributed capacity, though not completely, owing to the enormous difference between the electro-magnetic and the electrostatic time constants of the circuit. As an old truth in a novel form, I think they are worthy of publication.

REVIEW.

Submarine Cable Laying and Repairing. By H. D. WILKINSON, M.I.E.E. The *Electrician* Printing and Publishing Company, Limited, Salisbury Court, Fleet Street, E.C.

(*Continued from page* 91.)

An illustration of complete paying-out machinery is given on page 362, and is from a photograph taken on board the *Dacia*. The cable, however, is wanting. A better illustration of this description, showing a complete section of the ship's cable tank and a general view of the paying-out gear on deck, appeared some time ago in the *Scientific American*, and was reproduced in the ELECTRICAL REVIEW of January 10th last.

A sketch of the *Dacia's* friction table, or holding-back gear, is also shown on page 363. This piece of machinery, due to the late Sir Charles Bright, is a most valuable one. As Mr. Wilkinson remarks, V wheels are all very well in theory, but in practice are liable to lead to trouble if the compound on a cable is not quite the right thing, and clogs. We know of a case in which a friction table saved a serious accident. The ship was paying out cable on a rough night, and an unusually sticky compound clogged so much in the wheel leading the cable on to the paying-out drum, that the V was completely filled up, and in all probability the cable would have slipped off altogether, had not the friction table at once been screwed up, so as to put such a strain on the cable as caused it to force its way through the compound into the wheel. Any wheels—such as the one shown in fig. 61, page 108, are certainly to be avoided.

No illustration is given of a modern paying-out dynamometer. These are very much more sensitive than those used when picking up, and are specially designed. One on board the *Silvertown* is so sensitive, that indication is given of the moment at which the cable leaves the outside of the tank and comes into the eye, the diminished friction causing the strain to drop nearly half a hundredweight.

The horse-power which is absorbed by the brakes on a paying out machine with a speed of 7 knots would probably startle anyone who has not worked it out for himself. The reduction of a ship's speed from this cause should not be forgotten. There is more than one repairing steamer which would not be able to lay a deep water cable at any decent speed for this reason, if for no other.

Further information about the machinery of cable ships is to be found in Chapter II., "Types of Cable Ships." The picking up gear, designed by Mr. F. C. Webb in 1854, is shown on page 151, and in an appendix we are given views of that recently supplied to the Japanese steamer, *Okinawa Maru*, which is said to be of the very finest. These views, however, are not of much value. The *John Pender's* gear is shown in two illustrations, figs. 99 and 100. Other picking up gears, and useful remarks about them, are given on page 65. The very objectionable fleeting knife for a drum is shown on page 71. Unfortunately, there seems to be no way of doing without it. It it were not for the compound difficulty, something after that shown in fig. 84 would perhaps be better.

The bulk of the chapter is devoted to descriptions and views of cable ships. The *Faraday*—by the way, she is not of 5,000 tons. The *Silvertown*, of 4,935 tons, is the biggest cable ship afloat. The *Store Nordiske*, *H. C. Oersted*, H.M.T.SS. *Monarch* and *Alert*, late the *Lady Carmichael*, *Electra*, *Mackay-Bennett*, and *Retriever*, are all shown by outline sketches. This might have been supplemented by a table giving useful general information about telegraph ships. The capacity of cable tanks is dealt with in Chapter I., page 58. A simpler formula than that given to find the cubic content in feet of a mile of cable is $d^2 \times 33{\cdot}2$, where d = diameter of cable in inches. An allowance of 25 per cent. for waste space in coiling a heavy type of cable is not nearly enough. Double that would be safer.

Various grapnels in common use are shown on page 19, and some obsolete ones on pages 22 and 23, and sandwiched in between are remarks as to their method of employment. The ropes used are barely mentioned. Among special grapnels, nothing is said of the original cutting grapnel introduced by Mr. Latimer Clark, or of Mr. Lambert's improvement, which in turn was improved by Mr. Johnson.

The various operations of putting down a buoy, grappling, raising a bight, stoppering cable at bows, buoying, &c., are all dealt with, but, of course, in a very general way. For shallow water with strong currents 15 per cent. of slack on the moorings is recommended. Mr. Wilkinson will perhaps be surprised to know that 200 per cent. is frequently given, and found none too much. Down the Channel, for instance, a buoy will frequently move as much as 50 fathoms of heavy chain about on the bottom. It is not the pull of the actual buoy which causes this, but the effect of the current on the moorings themselves.

Fig. 19 is a novel and very good illustration showing to scale a ship grappling in 800 fathoms of water. Fig. 20 is from an actual photograph, and shows the difficult and dangerous operation of stoppering the two drum ropes on to the two parts of a cable, the bight of which has been lifted up to the bows on the grapnel. The sea on this occasion is a fairly smooth one, and no idea can be got of the difficulty under unfavourable circumstances. Fig. 21 shows a buoy prepared for cable, but the loose end of the stray leg of the bridle should of course be stopped up to the top of the buoy. It is also a good plan to stop its main part to the riding leg close under the bottom of the buoy, as this keeps it from swinging about, and enables the buoy to float more upright.

Under-running a cable has some few pages devoted to it. As originally introduced and practised by Mr. F. C. Webb, this was one thing, but, as a rule, it should never be permitted. There have been cases in which enormous damage has been done in this way, and there is no analogy between under-running by hand in a Dutch fishing smack and with a steamer propelled by her own engines.

The method of slipping a bight, shown on page 97, is not one to be recommended, and the author has apparently never seen it done, or he would not have drawn the dead eyes on the cable as though they were eye-bolts, instead of being on the end of an ordinary stopper.

Fig. 71 shows what is undoubtedly the right way of slipping a bight, but, of course, the ropes should be shown taut, and not slack.

We have now reviewed pretty well all that part of Mr. Wilkinson's work dealing with the practical operations, and

although we have found a good deal to criticise, this was only to be expected. There are so many different ways of doing a thing, that it is by no means an easy task to sit down and condense them into a few pages, and every expert at the work has his own ideas as to the best way of working. The great charm of Mr. Wilkinson's book is, that it is absolutely original. So far as we can see, not a single illustration has been taken from any other published work, and it is undoubtedly a most valuable contribution. Next week we hope to be able to commence dealing with the electrical portion of the book.

(To be continued.)

CORRESPONDENCE.

An International (?) Congress.

Noticing some paragraphs in the technical press announcing how certain American electricians of high standing were coming over as delegates to an International Electrical Congress to be held in Geneva in August next, it occurred to me to inquire what questions were to be discussed at this Congress, and who were the British delegates. As a member of the Electrical Standards' Committee of the British Association, I had heard nothing of any proposals, nor had I any recollection of any delegates being sent by the Institution of Electrical Engineers.

The replies to my queries only add to my bewilderment. Nothing has been heard of the proposed International Congress at the Foreign Office, at the Board of Trade, or at the General Post Office. Mr. Preece, who has attended every electrical congress hitherto, has heard nothing of this affair at Geneva, except what he has gathered from the recent press paragraphs, has had no invitation to attend, and is not going. No invitations to send delegates have been received by the Royal Society, by the British Association, by the Physical Society, or by the Institution of Electrical Engineers. Nothing is known of the proposal by any of these bodies, except the Institution of Electrical Engineers, the President of which, in February last, received from Messrs. Palaz and Cuénod, of Geneva, a circular announcing that an electrical exhibition would be held in that city, and asking the patronage of the Institution for a Congress of Electricians, to be held in August. The Council of the Institution, on March 26th, instructed the secretary to reply that they had pleasure in granting this request to enrol the Institution as a patron. At the same time, a corrected list of members of the Institution was forwarded to Geneva. Nothing more was heard until June 19th, when a circular, also signed by Messrs. Palaz and Cuénod, dated June 17th, and addressed to "The *Journal* of the Institution of Electrical Engineers, London," was received by Messrs. E. & F. N. Spon. In that circular the following paragraph occurs:—"Invitations to take part in the forthcoming Congress [on August 4th] are now being sent out, and with the object of making it more generally known, we take the liberty of asking you to be kind enough to make this known in your next issue." But the invitations appear never to have been sent! So far as I am able to ascertain, not a single English electrician has yet been invited to attend, nor have any of the scientific societies received any subsequent communication. It is now July 22nd; the "International Congress" is to meet on August 4th. Even if in the interim invitations should be received, it will be impossible for the Societies to appoint delegates.

Any decisions of a Congress so composed can carry little weight internationally. Assuredly England is justified in disclaiming beforehand all responsibility for the acts of a Congress gathered together in so informal a fashion?

Silvanus P. Thompson.

July 22nd.

Non-Blackening Incandescent Lamps.

With reference to the non-blackening incandescent lamp described in your issue of May 29th, 1896, I beg to suggest the following theory.

The deposition of the carbon particles on the interior of the lamp bulb is caused by the following, viz.: The loosened particles of carbon are transferred from the filament to the glass by static attraction, for the following reason. The filament whilst incandescent is in a much higher state of potential than the bulb of the lamp, which is, of course, at about the same potential as the air surrounding it, and therefore the loosened particles of carbon would be attracted from the filament to the glass, where they would remain when discharged. In the case of the double bulb lamp, the effect of the outer bulb would be to practically insulate the inner one from the atmosphere, so that it would almost be immediately raised to the same potential as the filament by the discharge of the first few carbon particles on it.

That portion of the inner bulb projecting into the air would, according to the above theory, be the only portion of the inner bulb at a low potential, and therefore the carbon particles would be attracted by it. In the case of an ordinary incandescent lamp exposed to a draught, the side that had the wind impinging on it most would be more rapidly discharged by the air than the other, and therefore more carbon particles would be attracted to it. As a remedy for the above, a metal wire entering through the lamp cap, and insulated from and central between the filament, would attract the carbon particles to it, this wire being, of course, "earthed." This would obviate the necessity of any outer bulb.

Molecular.

Modern Locomotion.

In these days of electric traction, autocars, and bicycles, I think you are to be congratulated on the very interesting matter you have provided for your readers in your issue of July 10th, as your articles on the Heilmann locomotive, the use of compressed air for driving tramcars, Mr. A. L. Steavenson's letter on the pull of a horse, and, lastly, Mr. Tomlinson's article on traction diagrams are all well worth careful reading by those interested in modern locomotion. In this latter connection, it is rather amusing to notice that one of your contemporaries in his review finds that Mr. Tomlinson's article is too much for his mental powers, being, apparently, choked off by a rather obscurely-worded passage at the commencement of the article on the value of traction diagrams; but, apart from this, the article is a thoroughly interesting one, and gives valuable hints and suggestions for new and convenient methods of obtaining theoretical traction diagrams as far as they are affected by the grading of any railway, tramline, or road.

I was for many years engaged in a similar investigation in India, and spent days on clinometric work, much of which would have been saved if Mr. Tomlinson's very neat idea had occurred to me of turning a car into a kind of direct-reading clinometer, speed indicator, and track measurer.

I think if Mr. Tomlinson had avoided using the word "line," sometimes meaning tram-road, and sometimes in its usual sense as a line on a diagram, he would have made paragragh 4, the one complained of in your contemporary, paragraph 9, and several others, much easier to read than they are at present. I suggest for the future that he uses the word tramline or tram-road.

R. E. Crompton.

July 21st, 1896.

On Celluloid and Accumulators.

Acting on the suggestion made by you a few weeks ago, I visited the Imperial Institute, and certainly received the object lesson you promised. No one who advocates celluloid after this can have had any experience with it. The maintenance account of a battery containing it would amount to a considerable item, that is, if the battery lasted long enough to require it. I happen to know one or two gentlemen associated with the origin of this battery, and while gazing upon their work, I could not repress a smile at the outward and visible sign of a mistake in one thing at least.

A Spectator.

Re X Ray Tubes.

I have just read your Note in this week's issue of your valuable periodical on the X ray tube, manufactured by the Allgemeine Elektricität's Gesellschaft, Berlin (and for which the Electrical Company, Limited, are the sole agents for this country). I write to draw your kind attention to the erroneous opinion expressed, that this is merely a *slightly* modified form of the tube which has been already in use in

England for several months; it has three electrodes and varies *widely* in every respect from the tubes at present on the market here.

Further, it has not "only just been discovered" in Germany, but was already a complete success as early as March last.

I think it only just to make these remarks, simply to prevent the public from believing this to be another proof of "brain-picking" of our German friends.

Jac. Stottner,
Chief Engineer to the Electrical Co., Ltd.

122—24, Charing Cross Road, London, W.C.

THE BROCKIE-PELL ARC LAMP, LIMITED.

This company, with a capital of £80,000, has been formed to acquire Messrs. Brockie & Pell's inventions for the construction of electric arc lamps as embodied in various patents and patent rights, and all future improvements on such patents and new invention that Messrs. Brockie and Pell may make or acquire, for the United Kingdom, Colonies (Canada excepted), the Continent of Europe, foreign countries (the United States of America excepted), India and Dependencies. The company will acquire the goodwill attaching to such patents, and the business connected therewith, and they will work and develop the said business in connection with the several patents and patent rights and otherwise.

The capital is divided into 80,000 shares of £1 each, of which 50,000 are now offered for subscription. The list opens on Monday next, and closes for London at 4 o'clock on Tuesday, and for the country on Wednesday at noon.

The company comes before the public not as a concern to establish a connection, but with a valuable business already built up, the profits from which, it is believed, will yield a handsome dividend to the shareholders. The business of the company will consist of, and their revenue be derived from, the manufacture and sale of the lamps and accessories, the granting of licenses, the supply of installations and plant, and the general business of electrical engineers.

The sale of the lamps is an increasing one. The year 1895 showed a continued increase, whilst for the first quarter of 1896 there was an increase of more than 27 per cent. over the corresponding quarter of 1895. It is also expected that considerable additional profits will accrue from the active working of the European, foreign, and colonial patents, which up to the present have been worked to a very limited extent.

The directors are of opinion that the sales of lamps alone should yield sufficient net profit to enable the company to pay a dividend of 7½ per cent., and also that as the company propose themselves to manufacture the lamps, the net income derived from this source alone should suffice to raise the dividend to at least 12½ per cent., and, further, that the profit on the manufacture and supply of accessories, the supply of installations and plant, the profit on repairs and on incidental business, should yield a further income, which should provide a total dividend of at least 17½ per cent. per annum. These figures leave out of count the profits to be obtained by the working of European, foreign and colonial patents.

To enumerate the number of places where Brockie-Pell lamps are used would involve a task of such magnitude that we dare not attempt it; suffice it to say that over 10,000 lamps have already been sold, and to those who know the high price they can invarialy command, the number is significant of the value of the business.

The special features in these lamps are well known; they give a steady light without flickering or variation; they are economical in carbon consumption, and as they burn 40 hours without attention or recarboning, the cost of maintenance is considerably reduced; they work satisfactorily on either constant current or constant potential circuits, and with continuous, alternating, or rectified currents; and as they have very simple mechanism, their working is easily understood, and they keep in perfect adjustment and good order for very long periods.

Dr. John Hopkinson concludes a ong report on these lamps with the following words:—

"Generally I was exceedingly well pleased with the lamps. No flicker could be detected, and that flicker is frequent in arc lamps is a matter of common observation. The lamps are focusing, which is a great convenience, inasmuch as the arc occupies always the same position in the glass shade; they are, therefore, readily adapted for use with reflectors. The lamps are as simple as a satisfactory arc lamp can well be, and I see nothing in them liable to get out of order, or requiring any exceptional attention. I know of no lamp better adapted for street lighting. Since I made my tests I have occasionally had Brockie-Pell lamps under observation, and I know of nothing to modify the favourable opinion I had formed of these lamps."

The services of Mr. Pell as managing director, and of Mr. Brockie as electrician and superintendent of the manufactory, have been secured to the company for the period of five years, and the board of directors consists of Lord Suffield, Sir Frederick B. Dixon-Hartland, the Hon. Reginald Brougham, H. W. Maynard, and Bennett Pell.

The working capital will be £15,000 cash, and £5,000 will be held in reserve in unissued shares. The outlay for the supply and erection of the necessary machinery for the manufacture of an annual output of more than double the present sales of lamps, is guaranteed by Messrs. Brockie & Pell not to exceed the sum of £4,783. The purchase-money payable by the company for the patents above-described, including goodwill, has been fixed by the vendors at £60,000, payable £30,000 in cash, £25,000 in fully-paid shares, and £5,000 in cash or shares, at the option of the company. The vendors pay all the costs of establishing and registering the company, and incidental thereto, up to allotment.

It is pleasant to chronicle the formation of a company to work such a legitimate business as this. We have known the co-inventors for years, their *bona fides* are unimpeachable, and under their guidance the company should have a very lucrative future, for we cannot see that the directors' estimate of profits are in any way overdrawn. We wish the company the success it deserves.

BUSINESS NOTICES, &c

Electrical Wares Exported.

Week Ending July 21st, 1895.	£	s.
Alexandria. Teleg. mtl.	6,000	0
Amsterdam	200	0
Algoa Bay	120	0
Bremen	25	0
Brussels...	40	0
Cape Town	140	0
Colombo	156	0
Copenhagen	621	0
Delagoa Bay	32	0
East London	171	0
Launceston	16	0
Mauritius. Teleg. mtl.	29	0
Monte Video	15	0
Melbourne. Teleg. mtl.	40	0
Oporto	22	0
Otago	99	0
Port Natal	64	0
" " Teleg. mtl.	92	0
Rockhampton	130	0
St. Petersburg	80	0
" " Teleg. mtl.	590	0
Shanghai. Teleg. mtl	59	0
Sydney	182	0
Tientsin. Teleg. mtl...	71	0
Wellington	429	0
Total	£9,423	0

Week Ending July 21st, 1896.	£	s.
Adelaide	26	0
Alexandria	26	0
Amsterdam	178	0
Auckland	13	0
Bilbao	35	0
Bombay...	127	0
Buenos Ayres. Teleg. mtl.	287	0
Calcutta	50	0
Cape Town ...	464	0
Delagoa Bay. Teleg. mtl.	33	0
Colombo...	697	0
Copenhagen	68	0
Durban	667	0
East London	870	0
Flushing	18	0
Gothenberg	325	0
Hong Kong	34	0
Launceston	61	0
Madras	86	0
Melbourne	333	0
" Teleg. mtl.	516	0
Monte Video	50	0
Montreal. Teleg. mtl....	30	0
Perth. Teleg. mtl. ...	273	0
Port Elizabeth	206	0
" Said	64	0
Shanghai	542	0
Singapore	120	0
Stockholm	160	0
Sydney	264	0
Townsville	1,142	0
Valparaiso	40	0
Total	£7,808	0

Foreign Goods Transhipped.

	£	s.		£	s.
Melbourne	70	0	Halifax	28	0

Annual Outings.—Messrs. Marryat, Lillywhite & Co.'s employés held their annual outing on the 18th inst. Proceeding to Maidenhead by train the party then made an all day river trip, staying at Medmenham for lunch, and returning to Maidenhead for dinner which was followed by a concert.

The employés of Messrs. F. A. Glover & Co., of 97, Queen Victoria Street, had their annual outing on Saturday last at Margate. Mr. F. A. Glover took the chair at the dinner, which was held at the Hotel Métropole.

The employés of Callender's Bitumen Telegraph and Waterproof Company, Limited, engaged in connection with the Strand and Charing Cross Company's Works, held their annual outing at High Beach on Saturday, July 18th, 1896. After an enjoyable drive, dinner was partaken of at the Robin Hood Hotel. The health of the firm was proposed, and Mr. F. R. Rowbotham, assistant engineer, responded, in the unavoidable absence of Mr. Reid, the chief engineer. The party then dispersed to cricket and other sports, leaving High Beach for home at 7.30 p.m.

Breach of Contract.—Messrs. H. & R. Lightfoot, at the recently held Manchester Assizes, sued for damages against Mr. T. D. Benson and Mr. R. Smith for breach of contract. The dispute arose out of the fitting up of some buildings with electric lighting. The defendants had stopped the work on the grounds that materials and workmanship were inferior, but the matter was compromised, a judgment being entered for the plaintiffs for £70.

Electrical Trades Union and the Provinces.—It is said that an attempt is being made to organise the electrical workmen of Sheffield, and to become affiliated with the Electrical Trades Union.

Electric Organ.—The new electric organ in Worcester Cathedral is to be dedicated next Tuesday.

Extension of Messrs. Verity's Works.—Messrs. B. Verity & Sons, who six months ago acquired the freehold of their Aston works, have now purchased the freehold of the neighbouring works, lately occupied by the Permanent Enamel Company, and also of a row of 14 cottages, by which they obtain possession of the whole of the surrounding block of property adjacent to their Aston works. As their present works are overcrowded, Messrs. Verity propose to devote the whole of the present buildings to their brass work, which will thus permit of the employment of 200 or 300 more men in this department of their business. Their electrical accessory and engineering work will then be carried on in a new factory mill to be erected on the site at present occupied by the Permanent Enamel Works. The plan for this mill, which will be four storeys high, has been arranged on the latest principles of fire-proof construction, and it will be worked throughout by electric motive power. As these buildings are being forthwith commenced, it is hoped that this new factory, together with the large foundries the firm are erecting on the adjacent wharf property, will be in active operation early in December. The whole of the land in the occupation of Messrs. Verity at Aston is thus their own freehold.

Gas.—Mr. Burnell, of Mildmay, sought for a leak of gas in the usual way, and found it. The house was partially wrecked and Mr. Burnell seriously injured.

Horseless Carriages.—In conjunction with the Laundry Exhibition to be held from August 24th to September 5th an exhibition of horseless carriages will be given at the Agricultural Hall.

Messrs. Crompton and Chelmsford.—As we announced some time ago, the difficulties of Messrs. Crompton securing a site for new works at Chelmsford have been overcome, and work has been practically commenced. Messrs. Dorman, Long and Co. have secured the contract for the iron work.

Messrs. Russell & Lennard.—This firm inform us that they are busy with the following installations, among others in hand:—Complete system of electro-magnetic separators for the Greenwich Inlaid Linoleum Company, Limited, with generating machinery; complete lighting of the Northern Polytechnic Institute; St. Ann's Church, Soho; St. Andrew's Presbyterian Church, Ealing; Kings Weigh House Chapel, Oxford Street; Dorset County Asylum Chapel; Manbré Saccharine Company's Works, Hammersmith; Shoreditch Fire Station (London County Council); London County Bank, South Kensington; Sutton Lodge, Chiswick. They are also doing work for the following:—Duke of Bedford; Sir Charles Lawson; Lady Miles. Among those recently completed are the offices of the Empress Assurance Corporation, Limited, Cornhill; Charing Cross Hospital (part); Wetherby Mansions, Earl's Court; Bramham Mansions; and many others.

New Catalogues and Price Lists.—Messrs. Rosling and Appleby, of Trafalgar Works, Bradford, have sent us an excellent price list of dynamos, motors, and coal cutting machinery.

From the Universal Electrical Fittings Company, Limited, comes a well-printed and admirably arranged catalogue of electrical fittings.

The D. P. Battery Company, Limited, have sent us a new price list of the D. P. storage batteries.

Messrs. Baird, Thompson, and Co. have sent us a very complete catalogue of their ventilating devices and other specialities.

Supply of Lamps to the French Admiralty.—The French Admiralty have entered into a three years' contract for lamps with Messrs. Gabriel and Angenault.

The Improved Electric Glow Lamp Syndicate, Limited.—The creditors of the above-named company are required, on or before August 24th, 1896, to send their names and addresses, and the particulars of their debts or claims, and the names and addresses of their solicitors (if any) to Mr. Samuel A. Bartlett, of 1, Arundel Street, Strand, London, the liquidator of the said company, and, if so required, by notice in writing from the said liquidator are, by their solicitors, to come in and prove their said debts or claims at such time and place as shall be specified in such notice, or, in default thereof, they will be excluded from the benefit of any distribution made before such debts are proved.

The Practical Electro-Plating and Enamelling Company, Limited.—Mr. James O. Asquith, liquidator of this company, announces that a general meeting of the members of the above-named company will be held at his office, 26, Trinity Churchyard, Coventry, on August 17th, 1896, at four o'clock, for the purpose of having an account laid before them, showing the manner in which the winding up has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator.

ELECTRIC LIGHTING NOTES.

A Disputed Electricity Bill.—Mr. Frederick Whiteley, a Halifax hatter, disputed the bill (£26 16s.) which the Corporation had rendered to him for electricity supplied. A gas inspector, of all people in the world, was called to prove the readings of the meter, and although the defendant urged that he had been previously supplied by Mr. Emmott with electricity for a similar period for £6, an order was made against him.

Aberdeen.—The Advocates' Library has been fitted for electric lighting by Messrs. Shirras, Laing & Co.

Bath.—It is said that the negotiations between the Corporation and the Bath Company, for taking over the works, are now complete.

Blackpool.—The Empire Theatre is now lighted by electricity. A separate plant is employed.

Blyth.—The North Eastern Railway Company are lighting the new staithes at Blyth by electricity.

Boston.—The Town Council have decided to light the town and docks by electricity.

Bristol.—The Local Government Board inquiry respecting the application of the Corporation to borrow an additional £75,000, will be held on the 29th inst.

Burrelton.—The villages of Burrelton and Woodside have been formed into a lighting district, and there is some talk of adopting electricity.

Bury St. Edmunds.—By 13 votes to 3, the Town Council has decided to adopt the electric light.

Church Lighting.—Messrs. Donnison, Berlyn, Evans and Co. are fitting up St. George's Cathedral, Southwark, for electric lighting.

Coventry.—An inquiry was held at Coventry on Tuesday by Mr. George W. Willcocks, M.I.C.E., an inspector of the Local Government Board, as to an application from the Corporation for a loan of £13,000 for electric lighting purposes. Of this sum, £3,200 was required for excess of expenditure in establishing the works last year, and £9,800 for extensions. The Town Clerk (Mr. L. Beard) and the consulting electrical engineer to the Corporation (Mr. R. Hammond) appeared in support of the application. The demand for electric light had increased so rapidly since the opening of the works at the beginning of the year, that extension of the plant and mains was absolutely necessary. The works opened with 1,824 8-C.P. lamps connected, and in six months the number increased to 3,700. Other premises are being wired. The present plant is:—One set capable of supplying 2,500 lamps, and the other 5,000. It is proposed to bring the total capacity up to 17,500. The headings of the extension items are:—Building, £1,440; machinery, £4,410; mains and transformers, £3,500; house services, meters, &c., £559; switchboard, £200. A demand was springing up, Mr. Hammond mentioned, for electric motors, and a motor had been purchased and put in the works to demonstrate to cycle manufacturers the economy of electricity. The inspector closed the inquiry, during which there was no opposition, and proceeded to view the works.

Calcutta.—The Municipality are permitting a private company to apply for license to light the town.

Cardiff.—The progress made in electric lighting in this town may be gathered from the fact that the number of incandescent lamps of 8 C.P., which twelve months ago was 4,992, has now increased to 12,642. The total number of units generated for June was 16,558, bringing in a revenue for the month of £273, against £141 last year. Besides the 32-watt incandescent lamps, there are 52 arc lamps for street lighting and 35 for private establishments. About 1,000 incandescent lamps which were previously run by private plants have now been connected to the Corporation mains. The plant at present installed consists of two 40-kilowatt and two 180-kilowatt alternators of the Siemens' type, the larger alternators running at 133 revolutions, and giving 72 amperes at 2,500 volts. The engines are three in number, viz., two triple-expansion marine and one compound marine. There are three Davey-Paxman boilers. A new Ferranti dynamo and engine combined will shortly be installed with two additional boilers. Ferranti rectifiers are in use and Siemens transformers. The longest main at present laid runs to a distance of 3 miles; the cables are of the rubber-covered type, but it is intended to use paper cables in the case of future extensions. Although few, if any, motors are run off the mains, the periodicity of the alternations, viz., 40, is especially suitable for the purpose. It may be mentioned that the price of the current per unit is 6d. for the first two hours, and then 3½d. The cost of gas in Cardiff is 2s. 10d. per 1,000 cubic feet, and it may be added that the Corporation inspector reported that during the month 2,470 public gas lamps were found to be defective. The electricity meters in use are the Shallenberger, Thomson-Houston, Ferranti, and Chamberlain-Hookham.

Darwen.—The Corporation have decided to ask an expert to report on an electric lighting scheme.

Devizes.—An application of Messrs. Brown & May to introduce electric lighting into the town has had the effect of making the Council consider the whole question of electricity supply.

Dundee Engineer Resigns.—Mr. Walter H. Brownlee, the Corporation engineer, has resigned his position on the grounds of ill health. Mr. W. M. Tittensor, Mr. Brownlee's assistant, have been appointed to act during the vacancy.

Edinburgh.—Additions and alterations at the Corporation electric lighting works, costing between £4,000 and £5,000, has been decided upon.

We are glad to see that the Electric Lighting Committee recommend establishing a renewal fund, but though the matter has been before the Town Council, no decision has been arrived at.

Electric Lighting in Belgium.—The Compagnie d'Electricité de Bortsfort is the title of a company which has just been formed at Watermael-Bortsfort with a capital of £10,800.

Dundee Harbour Lighting.—Committees of the Harbour Board and Corporation are considering the question of lighting the harbour by electricity.

Electric Lighting in Spain.—Tenders were recently invited for the concession for the electric lighting of the town of Ubiera (Seville province) during a period of 20 years, but not a single offer was received.

Eston.—Messrs. Cox-Walker have offered to light the district for a term of years for £385 plus 5 per cent. per annum. The matter is being considered.

Gateshead.—The Corporation are thinking of taking up the electric light, and a deputation has visited the Sunderland works.

Halstead.—The Urban District Council have considered a scheme of Messrs. Crompton. Inquiries are to be made as to the probable demand for lamps.

Keynsham.—The Parish Council will give an order to the Western Counties Company for the supply of 87 lamps of 20 C.P., if the price be reduced to that paid last year.

Kirkcaldy.—Prof. Kennedy's scheme, which involves £20,000, has been submitted to the Town Council.

Leatherhead.—A company is going to apply for a provisional order.

Lewisham and Greenwich.—The Blackheath and Greenwich District Electric Light Company propose to apply for a provisional order.

Lintwistle.—The question of lighting the parish is to be discussed at a ratepayers' meeting on the 28th inst.

Liverpool.—The Council have been recommended by the Lighting Committee to light the plateau of St. George's Hall and a portion of Lime Street by electricity.

Mitchelstown.—A company has applied for a provisional order for the lighting of this town.

Merthyr Tydvil.—The preamble of the Corporation Electric Lighting Bill has been passed by a Lord's Committee.

Morecambe.—Mr. T. Parker has been instructed by the local authority to prepare plans for the local Government Board to enable the Council to take over the undertaking of the Morecambe Electric Light and Power Company.

Morley.—Everything is now ready for the electric lighting scheme to be proceeded with. No objections have been deposited, and the plans have been proved.

Newcastle.—The only condition on which the Town Council will continue the electric lamps is the lowering of the price.

"Lux," writing to a local paper on the subject of Newcastle street lighting, says the time has come when electrically lighted streets should be the rule, and not the exception.

Newington.—The Society for the Promotion of Practical Progress, whatever that may mean, have held a meeting in Newington, at which Mr. Alderman Hubbard gave an address on "Ought the Parish to Supply Electric Light?" The lecturer argued in favour of the parish doing it.

Pier Lighting at Bournemouth.—The local company is to be asked to submit a scheme for lighting the Pier.

Railway Train Lighting.—It is reported that the Hungarian State Railway authorities have decided to adopt electricity for the lighting of the whole of their railway carriages.

Resident Electrical Engineer for Paisley.—The following gentlemen compose the short list for Paisley:—Mr. Bell, Manchester; Mr. Christie, Londonderry; Mr. Cooper, Blackpool; Mr. Pilling, Bolton; Mr. Teague, Coatbridge; Mr. Pender and Mr. Anderson, Paisley. The salary is £200.

Stretford.—The South Manchester Electric Light Company intend to apply for a provisional order.

Sunderland.—A resident engineer is wanted. Full details will be found under our "Official Notices."

Surbiton.—The Electric Lighting Committee of the Urban District Council recommend that the district be lighted by electricity.

Swansea.—The *Western Mail* thinks that in view of the revival of the tramway purchase and electric lighting scheme, it is strange that the Corporation should have invited tenders for the separate lighting of the new market.

The Kensington Company and the Vestry.—The Kensington and Knightsbridge Company have applied to the Vestry for leave to fix an elevator in front of their premises to facilitate the removal of ashes, but permission has been refused.

Theatre Lighting.—A new theatre, which is to be erected at Fulham, is to be electrically lighted from a private plant.

Wells.—In accordance with a previous resolution of the local authority, Dr. Hopkinson is to be asked to prepare plans, estimates, &c. There is great opposition to the introduction of electricity.

Wilmslow.—The District Council has resolved to apply for a provisional order.

Wellington (Warwickshire).—The District Council are to have an interview with the Brush Company's engineer with a view to lighting the town by electricity in ten months' time.

Yarmouth.—The Borough Surveyor, in his half-yearly report, submitted that the steadily-increasing demand would soon convert the loss on the electric lighting works into a gain. The difference between income and expenditure for 1895 was £766, £420 of which provided for the sinking fund. This was 75 per cent. below the estimated loss. The income for the present year to date was £1,082, and the expenditure £817, leaving £265 for sinking fund, &c., and as this was estimated at £600, there was a net loss on the six months of £335. The interest charges would be increased next half-year, and would probably amount to £800, but it was hoped that this would be met by an increased income. The money earned in the first half of 1895 was £570, and in the latter half £1,370, whilst that for the half year just ended was £530 more than in the corresponding period last year, the working expenses being only £155 in advance, and the latter was largely due to the continuous running through the day. He estimated that the loss for the whole of the present year would not exceed £400, and as by the end of the year 10,000 lights would be installed, it might be anticipated that in 1897 no loss would fall upon the rates.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Birmingham Central Tramways.—A special meeting of shareholders has approved the transfer of the business of the company to Messrs. Wm. Mackenzie and James Ross.

Central London Railway.—Mr. Grossmith, wholesale perfumer, of Newgate Street, has been awarded £9,000 as compensation for the compulsory acquisition of his premises by the Central London Railway.

Electric Traction in Germany.—An electric tramway is being constructed between Gustavsburg and Ginsheim. It is also proposed to construct an electric tramway between Murnau and Oberammergau, Bavaria. Plans are now being prepared for a projected electric tramway between Spandau and Westend, near Berlin.

Electric Traction in Belgium.—A Committee has been appointed in connection with the Société Belge des Ingenieurs et des Industriel to inquire into the relative merits of the overhead conductor and conduit systems of electric traction.

Electricity and Dairying.—Mr. T. Robins F. Bolitho, J.P., of Trengwainton, near Penzance, has applied electric motors to dairying work.

The Douglas Southern Tramways.—This line was formally opened yesterday week.

Kidderminster and Stourport Electric Tramway.—The preamble of the Bill which provides for the erection of this tramway has been held by a Lords Committee to be proved.

The Locomotives on Highways Bill.—The following is the text of the Bill as amended by the Standing Committee on Law, given by the *Engineer*. It is intituled an Act to amend the Law with respect to the Use of Locomotives on Highways, and the additions made since the Bill passed the House of Lords, as published in our impression of July 3rd, are shown by the words in italics.

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

(1): 1. The enactments mentioned in the schedule to this Act, and any other enactment restricting the use of locomotives on highways and contained in any public general, or local and personal Act in force at the passing of this Act, shall not apply to any vehicle propelled by mechanical power, if it is under *three* tons in weight unladen, and is not used for the purpose of drawing more than one vehicle (such vehicle with its locomotive not to exceed in weight unladen four tons), and is so constructed that no smoke or visible vapour is emitted therefrom *except from any temporary or accidental cause;* and vehicles so exempted, *whether locomotives or drawn by locomotives*, are in this Act referred to as light locomotives.

Provided *that*:—

(*a*) *A county authority shall have power to make bye-laws preventing or restricting the use of such locomotives upon any bridge where such authority are satisfied that such use would be attended with damage to the public, subject to an appeal to the Local Government Board by any person aggrieved by the exercise of the power.*

(*b*) A light locomotive shall be deemed to be a carriage within the meaning of any Act of Parliament, whether public, general, or local, and of any rule, regulation, or bye-law made under any Act of Parliament, and, if used as a carriage of any particular class, shall be deemed to be a carriage of that class, and the law relating to carriages of that class shall apply accordingly. 2. *In calculating for the purposes of this Act the weight of a vehicle unladen, the weight of any water, fuel, or accumulators used for the purpose of propulsion shall not be included.*

(2) The keeping and use of petroleum or of any other inflammable liquid or fuel for the purpose of light locomotives shall be subject to

regulations made by a Secretary of State, and regulations so made shall have effect notwithstanding anything in the Petroleum Acts, 1871 to 1881, and breach of any such regulation may, on summary conviction, be punished by a fine not exceeding ten pounds.

(3): 1. The Local Government Board may make regulations with respect to the use of light locomotives on highways, *and their construction and other conditions under which they may be used*, and a breach of any such regulations may be thereby made punishable by a fine not exceeding ten pounds, recoverable on summary conviction. 2. *Regulations under this section may, if the Local Government Board, deem it necessary, be of a local nature, and limited in their application to a particular area.*

(4) *The requirements of sub-section four of section twenty-eight of the Highways and Locomotives Amendment Act*, 1878, *may be from time to time varied by order of the Local Government Board.*

(5): 1. In the application of this Act to Scotland a reference to the Secretary for Scotland shall be substituted for a reference to the Local Government Board.

(6) In the application of this Act to Ireland a reference to the Local Government Board for Ireland shall be substituted for a reference to the Local Government Board.

(7) This Act may be cited as the Locomotives on Highways Act 1896.

The Schedule is as published in our impression of the 3rd inst.

The Dover Trams.—A motion by Alderman Adcock that the surveyor be instructed to prepare the necessary plans and specifications for the proposed trams has been defeated by one vote.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-American Telegraph Company.—In the *Statist* we read the following:—"If the project of a cable from Vancouver Island to the Australasian colonies should be carried out, the Anglo-American Company should obtain some of the traffic which at present is secured by the Eastern Telegraph Company. At the next half-yearly meeting, information as to how the French lawsuit business stands would be acceptable to proprietors. This matter has been dragging along for several years, and one would like to know the prospect of its being concluded, and, if in favour of the Anglo-American Telegraph Company, what would be the sum likely to come to it."

Glasgow Corporation Telephones.—A deputation of the Glasgow Corporation was received by the Postmaster-General last Saturday with reference to the application for a telephone license. It was pointed out by the Duke of Norfolk that he would be unable to make a definite statement, as the Government were considering the whole matter.

Personal Injuries and Damages.—Patrick Milligan, an employé of the National Telephone Company, sued his employers in the Birkenhead County Court for £114 as damages for injuries said to have been caused by the negligence of the company. When climbing the roof of a house at Liscard for the purpose of passing a wire, he fell to the ground. After consultation, a settlement for £60 was arrived at.

Post Office Telephone Service.—Hull merchants are complaining of the length of time the Post Office take to put a subscriber on to the telephone trunk lines.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Bissao-Bolama	May 30th, 1896 ...	...
Cadiz-Teneriffe	June 7th, 1896 ...	July 16th, 1896.
Para-Maranhao	July 9th, 1896 ...	July 16th, 1896.
Lourenço-Marques-Durban ...	July 13th, 1896 ...	...

Telegrams may be sent *vid* West Coast route. Landline between Delagoa Bay and Durban in bad condition.

Landlines.		
Trans-Continental line beyond Mazol (Mashonaland)	March 12th, 1896 ...	...
Bolinao-Manila	March 19th, 1896 ...	...
Communication with Cartagena and Barranquilla, Columbia.	July 4th, 1896 ...	...
Communication with Cuenza, Machala, Santa Rosa, Laja, and Guaranda	July 10th, 1896 ...	...
Communication with Quito (Ecuador)	July 15th, 1896 ...	July 17th, 1896.
Siberian lines Werkhne Oudinsk-Tschita	July 21st, 1896 ...	...

Pacific Cable Conference.—We understand that it has been found advisable to postpone the sittings of the Pacific Cable Conference until October next, as Sir Donald Smith and Sir Mackenzie Powell have had to sail for Canada.

The Telegraph Congress.—At a plenary sitting of the International Telegraph Conference at Buda Pesth, several clauses were introduced into the International Telegraph Statute which are of interest to the general public. For instance, it was arranged that Christian and surnames, as well as whole numbers and fractions or decimals, shall be counted as one word. The maximum number of letters in a word has also been raised to fifteen for European, and ten for transoceanic telegrams. At a previous plenary sitting it was decided that a polyglot text should be permitted on international cables, and that telegrams without text, consisting of the address alone, should be allowed universally.

The Kensington Vestry Again.—The National Telephone Company applied to the Kensington Vestry for leave to lay pipes in Brompton and other neighbouring roads, for the purpose of giving their subscribers the twin-wire service, but the application was refused.

CONTRACTS OPEN AND CLOSED.

OPEN.

Armagh.—August 3rd. The Commissioners for the Control of Lunatic Asylums, Custom House, Dublin, want tenders for the erection of an electric light installation for the Armagh Asylum. Particulars from the secretary.

Germany.—July 25th. Tenders are being invited for the supply and erection of the plant and fittings required for the electric lighting of the railway station at Bretten. Tenders to the General Direction of the Grosse-Badische Staats-Eisenbahnen, Carlsruhe.

Madras.—Nov. 11th. Lieut. Col. C. C. Rawson (in charge Consulting Architects' Division) invites tenders for the lighting by electricity of Government House, Madras, including the banqueting hall and the A.D.C.'s bungalow: also for the lighting of Government House, Guindy, including the Military Secretary's bungalow. Particulars to be obtained on application to the Consulting Architect to the Government of Madras, Chepauk, Madras.

Mexico.—August 31st. The Secretary of State for Foreign Affairs has received from the British Consul at Mexico, a pamphlet issued by the municipal council of that city, containing particulars as to tenders which are called for, for the public lighting of the city by electricity, and which must be put in by the last day of August, 1896. This pamphlet may be seen on application to the Commercial Department of the Foreign Office, between the hours 11-6.

Mexico.—Sealed tenders will be received by the secretary of the City Council of the City of Mexico, not later than the last day of August of the current year, for the lighting of the city by electricity. All information and conditions of tender, plan of the city of Mexico, &c., can be obtained on application at the Mexican Consulate, Broad Street House, New Broad Street, London.

Mile End.—July 30th. The Guardians want tenders for the supply and erection of electrical plant, laying mains, and wiring, &c., for lighting their premises in Bancroft Road, London, E.

Southampton.—August 10th. The Harbour Board wants tenders for the construction and erection of four electric cranes. For further particulars see our "Official Notices."

Spain.—The Municipal Authorities of Arevalo (Avila province) are at present inviting tenders for the electric lighting of the public streets of the town under a 20 years' concession. Tenders to be sent to El Ayuntamiento de Arevalo (Avila).

CLOSED.

France.—The General Direction of the French Posts and Telegraphs has placed the contract for 25 kilometres of telegraph cable, tenders for which were recently invited, with M. A. Grammont, of Pont-de-Cherville (Isère).

Wakefield New County Offices.—The following is a list of tenders for electric lighting:—

	£.	s.	d.
Belham & Co., *(withdrawn)*	1,480	0	0
T. Harding Churton *(accepted)*	1,527	10	0
J. A. Edmondson	1,750	0	0
Maunsell, Mercier & Co.	1,827	18	10
E. Scott & Mountain	2,150	0	0
Rashleigh, Phipps & Co.	2,326	0	0
Paterson & Cooper	2,350	0	0
Strode & Co.	2,445	0	0
Brush Electrical Co.	2,700	0	0
G. A. Steinthal	2,800	0	0
Laing, Wharton, & Down	4,160	0	0

NOTES.

Death from Electric Shock.—On Monday last, Mr. Arthur C. Langham, the deputy-coroner, opened an inquiry at the City Coroner's Court with reference to the death of Mr. John Jackson Chisholm, aged 30 years, the sub-foreman of the distributing stations of the City of London Electrical Lighting Company, Limited, who was killed on Thursday at the Crosby Square Station, Bishopsgate. Major Cardew watched the case on behalf of the Board of Trade, and Mr. H. J. Cameron, her Majesty's Factory Inspector, appeared for the Home Office. Mr. William Parry, of Fitzgerald Avenue, Mortlake, the chief foreman of the City of London Electrical Lighting Company, stated that on Thursday afternoon he and the deceased and a Mr. Howe went to the Crosby Square station for the purpose of testing. It was intended to make the connection with the St. James's Square station "alive," with the view of shutting off the main at the station. To do this they used the Silvertown portable testing set, and having completed the work satisfactorily the deceased went to put the inner conductor or cable back into the terminal, but suddenly he fell back as though he had received a shock. The Coroner: Was the deceased using gloves? Witness: Evidently not. The Coroner: Is it usual to wear gloves? Witness: Yes. The Coroner: Were gloves provided? Witness: Yes, rubber ones, and they were within 2 feet of him at the time. A Juryman: Who is responsible for seeing the gloves were used? Witness: Deceased was his own master, and if he said he preferred to use his hands, none of those present could have said anything. Mr. Horace Howe, assistant engineer, of 79, Angell Road, Brixton, stated that the deceased was stooping when the accident occurred, and might have slipped or overbalanced while reaching for the gloves. Major Cardew: Could the accident have been caused by anyone at the St. James's Square station making the terminal "alive" again? Witness: Yes, easily. Major Cardew: Was it possible for anyone to do it at St. James's Square without your knowledge? Witness: It was possible, but could hardly have been done as only two men were allowed to do that work, and the deceased was one. Dr. Frederick Clark, of Gt. St. Helen's, Bishopsgate, stated that he tried to restore the deceased by means of artificial restoration, but without effect. An autopsy proved that death was due to an electric shock, and between the thumb and index finger of the left hand was the mark where the charge had entered. A Juryman: The question of whether anyone did or did not make the terminal "alive" again has not been proved. The Coroner: If you wish to go into that point the inquiry must be adjourned for the attendance of the men from the St. James's Square station. An adjournment for a week was ordered.

Electrical Sanitation.—Messrs. E. Hermite, E. J. Paterson, and C. F. Cooper, inform us under date June 30th!! the circular letter reaching us on July 18th, that they have commenced proceedings against the British Electrozone Corporation, Limited, for an injunction to restrain them from infringement of patents and for damages, it being alleged by our correspondents that the process adopted by the defendants is an infringement of the method protected by the plaintiffs' patents. The British Electrozone Corporation, Limited, now inform us, in answer to inquiries, that action has been commenced, and that the application for an injunction was defeated. The corporation deny the validity of the Hermite patents, and assert that their process is wholly different from anything referred to by Hermite and others in the patents in dispute. Being still, we suppose, *sub judice*, we are unable to express any opinion on this action, although we hold strong views on the matter at issue.

The Sullivan Universal Galvanometer.—This galvanometer was recently adopted on Her Majesty's telegraph ship *Monarch*, and has given complete satisfaction on board. The gist of the report on the instrument being that it works perfectly in all weathers, and is a great improvement on the Thomson ironclad marine galvanometer hitherto exclusively used on board ship. This information is sent to us with the permission of Mr. W. H. Preece, Engineer-in-Chief of the Post Office. We are requested to state that all orders for the instrument should now be sent to Mr. Sullivan.

Fuse Wires.—Professor W. M. Stine, in a summary (*American Electrician*) of practical conclusions on the subject of fuse wires, gives the following:—1. Covered fuses are more sensitive than open ones. 2. A fuse wire should be rated for its carrying capacity for the ordinary lengths employed. 3. On important circuits fuses should be frequently renewed. 4. Fuses up to 5 amperes should be at least 1½ inches long, ½ inch to be added for each increment of 5 amperes capacity. 5. Round fuse wires should not be employed in excess of 30 amperes capacity. For higher currents flat ribbons of 4 inches and upwards should be used. His experiments have shown that for large fuses a multiple fuse is more sensitive than a single one. A one hundred ampere fuse may be made by taking four wires of 25 amperes capacity. Too much emphasis has been doubtless placed on the position of a fuse. Unless it be long and quite heavy, its carrying capacity is practically the same, whether it be placed vertically or horizontally. Experience seems to show that the best alloy is one of lead and tin, the lead being considerably in excess. If too much lead is used, the fuses deteriorate rapidly and coat with the white film. A leading question now is the automatic circuit breaker *versus* the fuse wire. Both these devices are excellent in themselves, but each requires judgment in selection and use. The automatic circuit breaker is to be preferred for switchboard use and motor service. Large fuses should be avoided, as they are both filthy and dangerous. Relegated to the back of the switchboard, the flying molten metal fouls the bus bars and connections, besides coating the board with a sooty deposit. A circuit breaker placed in plain sight on the front of the board is to be preferred in all cases. For lighting circuits, it is doubtful if any simpler and better device than the fuse wire can be used. In spite of all that has been said against it, when properly used and taken care of, it leaves little or nothing to be desired; yet there is nothing about the plant that is more dangerous when ignorantly or carelessly used.

The Power of a Horse.—There is a critic who always has his jaundiced eye on our columns, whether to carp at ourselves or our correspondents. In his haste to get at our correspondent, Mr. Steavenson, however, he allowed his physiological ignorance to blind him somewhat. Mr. Steavenson referred to the power exerted by a horse at the moment of starting, and our critic animadverts upon this on the ground that a horse pulling against a resistance and not moving forward can be doing no work, there being no motion. This may be true of a steam-pressed piston, but it is not true of animal power. The horse must expend energy in keeping a stress upon its traces, and to attempt to draw strict mechanical parallels without brains is an erroneous proceeding, though possibly well suited to our critic's capacity. Let him try lifting himself in a basket. He may then perceive that, though he will be performing no useful work—a condition of things to which, no doubt, he is accustomed—he will, in keeping up a steady upward pull, be expending energy that would in time tire the strongest and longest arm.

Electrical Autocars.—The improvements announced by the E.P.S. Company which have been made by Mr. King on the secondary battery, brings the use of batteries for auto-cars within the bounds of successful application in some cases. A 3 H.P. battery now weighs only 1,300 lbs., and occupies 9½ square feet of floor space, a 3 H.P. motor added to this would, at 60 lbs. weight per horse power, reach a total weight of 1,480 lbs. Although this weight is yet too great for light vehicles such as are usually run by a single horse, it is a great improvement, and will enable battery traction to be tried on heavy vehicles, omnibuses, parcels vans, and so on. We hear of further improvements for light cars, in which a cheap but short-lived battery is proposed. The idea is to employ a small battery and renew it often, the battery to be constructed with that in view, and reduced to the lowest possible weight.

The Electrophone Company.—We have often spoken of the enterprise of this company, but it bids fair to surpass all its previous efforts. It has issued invitations to attend at the offices in Gerrard Street, W., and "hear the proceedings at the Royal Courts of Justice during Dr. Jameson's trial." Judging by our experience of an evening spent at the Electrophone Company's offices some time ago, we should say that the experiment will prove completely successful.

Where Does the Energy Go?—The *Electrical Railway Gazette* asks:—Of the 25 or 30 horse-power of electrical energy that is given to the railway car most of the losses are accounted for. The motor field-magnets take a certain amount; the armature losses are estimated; the friction of the bearings is measured, and in a good equipment the aggregate of the losses amount to not more than 20 per cent. of the total amount of energy applied. Where does the rest go when the car is on the road? There is no question that the entire 25 horse-power is consumed, and 5 horse-power has been repeatedly demonstrated to be sufficient to overcome the friction of the bearings and other losses. What has become of the extra 20 horse-power? It requires energy to get the car in motion, but this energy is frittered away in heat and ultimately lost at the brake shoes when the car comes to a standstill. It requires energy to climb a grade, but it is all returned on the subsequent descent. In other words, it can all be traced to consumption by the friction of the wheels on the track and on the brake-shoe, with the exception of a small amount due to air resistance. It is degraded to uniformly diffused heat. This is noticeable from a practical standpoint. When a car returns from a round trip, even though the brakes have been applied but little, the wheels are always warm, and not infrequently hot enough to burn the fingers. In theory no energy should be necessary to move a car around a belt line and return it to the same place in the car-barn. All that is used is wasted in heat on the way. Much time and expense have been spent in efforts to minimise motor losses. Why is it not as reasonable to seek to reduce the 80 per cent., which is waste just as truly? The bearings, the brake-shoes, and the wheel-treads are the centres of this wasteful distribution of energy. It is easy to localise the loss, but few seem to strive to reduce it.

City and Guilds of London Institute.—At a meeting of the Council of the City and Guilds of London Institute, held on Monday, the 20th inst., the diploma of "Associate of the City and Guilds of London Institute" was conferred on the following matriculated students who have this year successfully completed a full course of instruction at the City and Guilds Central Technical College:—

Civil and Mechanical Engineering.	Applied Physics and Electrical Engineering.	Applied Chemistry.
Gore, W. (Siemen's Medal).	Ray, E. (Siemens' Medal).	Lowry, T. M.
Cooper, V.	Taylor, C. A.	Renwick, E. F.
MacColl, A. M.	Braby, I.	Pope, T. H.
Wilson, J. S.	Maquay, G. A.	Gilles, W. S.
Price, B.	Ricks, G. W. D.	Shelton, A. J.
Bayley, D. H.	Tucker, P. A.	Deerr, N. F.
Baker, R. F.	Morgan, E.	Sayer, H. C.
Barry, I.	Watlington, Y. V. E.	Panisset, S. G. S.
Weekes, M. G.	Barber, C.	
Salmon, C. E. H.	Rigden, P. F.	
Temple, L.	Collard, J. F.	
Jaffe, D. J.	Phillips, W.	
Saunders, H. J.	Pringle, J. F.	
Kirkby, H. M.	Vance, C. E.	
Jones, J. A.	Gridley, H. J.	
Kenrick, A.	Hesse, H. F.	
Buckley, A. B.	Scears, M. J.	
Perry, G. S.	Daniel, W. F.	
Mair, G. P.	Steuart, W.	

The Use of Accumulators with the Alternate-Current Supply at Zürich.—The night load at the central station lighting, Zürich being near the maximum output of the station, and the street mains, moreover, not being adequate for dealing with much heavier currents than those employed at the time, it was decided, when current was required for a large new music hall, to light the same by means of direct currents from accumulators, says the *Electrotechnische Zeitschrift*. These accumulators are charged during the day by means of rectified alternate currents, so that, in addition to relieving the night load, the day load is increased, and thus much more favourable conditions obtained for the economical working of the station. The consumption of current at this music hall (the "Neue Tonhalle") is equivalent to 2,000 16-candle-power lamps. The plant is installed in the cellars of the Neue Tonhalle, and comprises a battery of accumulators, two current rectifiers, the switches, and measuring arrangements. Moreover, in view of the novelty of the arrangement, an alternate to continuous-current transformer was put in as a reserve.

Electric Transmission of Power from the Coal Mines.—The *Engineering and Mining Journal* announces the incorporation of the Pacific Transmission Company, of San Francisco, which marks the beginning of an interesting project for the electrical transmission of power from the mouth of California coal mines. The company will be controlled by the San Francisco and San Joaquin Valley Coal Company, whose mines are at Corral Hollow, in Alameda County, and is one of several important undertakings connected with that corporation. The new company will have a capital of $3,000,000, divided into 30,000 shares of the par value of $100 each, and will be empowered to build and operate steam and electric plants at the coal mines in Corral Hollow and Alameda County for the purpose of generating electrical power, and furnishing the same by transmission over wires to Oakland by way of Livermore, Haywards, San Leandro, and other towns *en route*, and also to San Jose and to Stockton. It is intended to ultimately extend the service to San Francisco. The cheapest item connected with the generation of the electrical power will be the fuel, which will consist of the waste and refuse screenings, dust, &c., from the coal produced at the extensive Corral Hollow mines. The supply of this kind of fuel will be almost inexhaustible, and as it is extracted from the mines with the merchantable coal, it is all paid for by the latter. As the coal company will control the transmission company, there will be no charge for this fuel. The plant at the mines will generate at the start 6,400 H.P., of which about 5,000 H.P. will be supplied to San Jose and to Oakland, through the towns *en route*, and afterward Stockton, will be taken in, and if necessary the supply can be increased so as to extend the service even to San Francisco and other more distant points. The company expects to furnish this power to Oakland, San Jose, Stockton, and intervening places at $60 per H.P. per year. The present cost ranges from $60 to $80, according to conditions.

Electric Lamps.—The *Gas World* quotes from an article by S. Freund in the *Zeitschrift für Electrotechnik*. He says there are two kinds of lamps made, one of which the makers do not readily dispose of, because the public does not understand them, and the electric lighting companies do not like them, these being the short-life and low-consumption variety. A lamp which is not expected to last more than 300 hours may be made to use only 2·5 to 2·8 watts per candle to begin with, and from 3·2 to 3·5 watts after 350 hours. During 800 hours, such a lamp, with an average consumption of 2·85 watts, and renewals every 300 hours, each lamp costing 1s. 3d., with current at 5d., would cost 17s. 10d. On the other hand, the usual lamp begins with 3·5 watts per hour, or, in the English makes, 4 watts, a circumstance which contributes to the so-called solidity of the English make; and in 800 hours it reaches 5·3 to 6·2 watts per candle. Taking the average at four, and one renewal every 800 hours, the cost of lighting for 800 hours, with current at 5d., and lamps at 1s., is 22s. 4d. But observe that the candle spoken of is the Hefner unit; so that we would have, in round numbers, to add 10 per cent. to the consumptions per candle spoken of by Herr Freund. He says that at the end of the 800 hours service of the coarser lamp its lighting power has fallen by 35 to 40 per cent., while at the end of the 300 hours' service of the other kind, it has only fallen from 18 to 20 per cent.

Islington Vestry and its Electrical Engineer.—We cannot admire the manner in which certain of the members of the Vestry of St. Mary, Islington, discuss some of their affairs. At a recent meeting of the Vestry, the Electric Lighting Committee suggested that Mr. Gay's salary be increased from £400 to £500. This was eventually very properly accepted. We pass over one member's seeming grievance, namely, that a working man was only getting 8d. an hour, and a professional man 5s. an hour; but when another suggests that the salary be increased on the grounds that many accounts passed through the engineer's hands, and it was not well that he should be underpaid, we think that a distinct slur is being put upon the electrical engineer, a slur against which we most strongly protest. As a German would say, the "broughtings up" of some vestrymen have evidently not been on the lines of all that is best in English manhood.

Electrolytic Action in a Boiler.—A western correspondent asks the *Electrical Journal* of America if there is a chance for sufficient electrolytic action to take place in a boiler as to make it unsafe by causing its rapid destruction. Why, certainly, is the reply, if the electrolytic action is at all strong it will cause the rapid destruction of the boiler. The amount of damage it will produce will depend on the strength of the action and the length of time it is allowed to continue. A very small amount of electric current is sufficient to so energise chemical action as to produce effects that would not be noticeable under similar conditions, except that there was no electric action involved. Electrolytic action is similar to that called by chemists "galvanic action," the action and results being almost identical. A grounded electric wire, making contact with a water pipe and another contact from a lamp circuit, on a steam pipe, caused the flow of sufficient current through a boiler to produce noticeably destructive effects on some brass valves and a portion of the iron feed pipe. The amount of current in this case was that which passed through one lamp and was distributed through two paths, consequently much less than half an ampere, yet the effect was such that, had not the cause of the trouble been discovered and removed, serious results might have soon followed. Sometimes electrolytic, or galvanic, action is produced in a boiler by reason of a galvanic current caused by the action of the water in the boiler acting as an electrolyte on the different kinds of metals composing the boiler and its fittings. All the conditions are present for forming an electric cell, which the boiler really becomes when the water has sufficient conductivity and contains certain chemicals in solution. Where a boiler is subjected to electrolytic or galvanic action, it is best to have the water analysed and to determine the cause of the trouble and means employed to neutralise it, if the mechanical cause cannot be discovered and removed.

Experimental Street Lighting in the City.—The Streets Committee of the Commissioners of Sewers, remarks the *Times*, have recently embarked upon a series of experiments in electric and incandescent gas lighting in some of the minor streets of the City, with the view of determining the best system of illumination to be generally utilised in the future. In Wood Street incandescent gas lamps have been erected, and they supersede, to some extent, the former distribution of light by gas, with greater illuminating power. In Watling Street, Old Change, Friday Street, Bread Street, and Bow Lane, the electric light has been used, the lamps being of fundamentally different kinds—namely, the arc and the glow. For the sake of comparison, some of these have been fixed on brackets, while in other instances the lamps have been suspended above the centre of the roadway, far removed from any possibility of contact by vehicular traffic. The Streets Committee of the Commission will present a report to the members of that body in the near future recommending what they consider to be the best form of illuminant. When this question has been definitely settled, the Commission will proceed to light by some other means than the present the minor streets of the City.

Patriotism and Science.

(From *Life.*)

Little Willie's cast-iron cannon
Ne'er had felt the Roentgen ray;
Perfect was it in appearance,
But a flaw was hid away.

Little Willie's bones and muscles
All were photographed next day,
So they might collect that cannon
Aided by the Roentgen ray.

"A Wonderful Primary Battery."—Such is the title of an article in the *Pall Mall Gazette* of Wednesday last. Unfortunately, the writer is about two years behind the times, for the cell, which "is a marked advance on anything we have ever seen," as our enterprising contemporary puts it, is nothing more nor less than our old friend the Walker-Wilkins battery, with which we dealt in a very complete manner in our issues of January 18th and 25th, 1895. The article shows an utter lack of knowledge as to what has been done in primary battery exploitation, and forms an excellent example of what we complain of in pages 97 and 99 of our current number.

Bonding Tram Rails.—The question as to whether it is or is not necessary to specially bond electric or cast welded track joints is one which it is not at all easy to solve, for the reason that so much depends upon the mechanical perfection of the joint made in each particular case. Judging by letters published in the *Street Railway Journal* from a number of street railway managers who are using cast welded joints, it seems that there is a decided difference of opinion on this subject. It would appear that in many of these joints a portion of the metal of the rail itself is fused, so as to make a union amounting practically to a complete weld between the molten metal of the joint and rail. In some cases, however, probably where the rail surfaces are not cleaned with sufficient thoroughness, the joint surfaces are honeycombed, so that the "weld" is not complete. It does not, of course, follow from this that the joint, considered purely from the point of view of its service in the track, is poor; but it may quite possibly be true that the joint is not electrically good without auxiliary bonding. It has been noticed also, in one or two cases, by those using the cast welded joint, that the electrical conductivity seems to deteriorate with the length of service, this being very possibly due to the jarring apart of the joint surfaces to an extent unappreciable, as far as the strength of the joint is concerned, but of some importance as regards electrical conductivity. It is not an easy matter to test these joints to determine whether or not bonding is necessary, since it is impossible to completely insulate a long stretch of track, so as to accurately measure the loss in voltage due to the passage of a heavy current, while the loss at each joint, even when the latter is comparatively poor electrically, should be so exceedingly small as to be difficult of measurement. The best way of determining track resistance is to measure the fall in potential between the ground bus bar at the station and any point on the track system, by means of a test wire strung upon the poles on every street throughout the system, and in this way defective lengths of track, or even defective joints, can usually be found.

Some Ancient Literature.—A trans-Atlantic newspaper records that at the recent electrical exhibition at New York, Dr. Park Benjamin exhibited some very ancient books on electricity. The following details regarding same are exceedingly interesting:—

Dr. Park Benjamin owns a copy of the first printed book relating to electricity. It appeared in 1490 in an edition of "The Lives of the Philosophers," by Diogenes Laertius.

The Chinese classic, "Shoo King," shows that the ancient Chinese had a knowledge of the compass and its uses.

In the famous treatise of William Gilbert on the magnet, printed in 1600, the word "electric" is for the first time recognised as a branch of science.

The so-called "magnetic powder" of the Middle Ages was made from skulls and other gruesome materials. It was never applied to a wound, but to the weapon which had made the wound.

Porta's idea of a magnetic telegraph operating by the sympathy of two distant magnets was ridiculed by Galileo.

The original edition of Charleton, published in 1650, is especially remarkable because the word "electricity" is used in it for the first time. Gilbert had before this used the word "electric."

A picture of the first steam engine is to be found in a Venetian translation of 1575 of the book of Hero of Alexandria.

In the old Italian book of Branca, Rome, 1629, is represented a steam wheel turbine.

In the first book describing an airship, the author proposes to raise a car by means of "four copper balloons."

Otto von Guericke's book, issued in 1672, describes the first electrical machine ever made. He also describes electric light, electric sound conduction and polarity.

Robert Hooke, who wrote in 1707, was one of the most ingenious of the early electricians, and suggested the phonograph.

In 1743 the Germans believed that fire existed in the human body, and could be made to come out electrically.

German writers first suggested the use of electricity for medical purposes.

The first book on electricity that ever came into the United States belonged to Benedict Arnold, the traitor, and is still extant, with his autograph on it.

John Wesley, the founder of Methodism, wrote a book on electricity.

Is it Humour?—The following appears in the *Financial Times*:—

Charing Cross and Strand Electricity Supply.

The directors of the London, Tilbury, and Southend Railway Company have, subject to audit, declared an interim dividend for the half-year ended June 30th, at the rate of £5 per cent. per annum on the ordinary share capital, and carried forward £6,100, after payment of all interest on debentures.

Horseless Carriages.—From recent careful observation of the behaviour of petroleum driven carriages, it is surprising to us that many of the French people can run their vehicles at all. They appear to think that the engine needs no attention. Many carriages which in their hands have given difficulty, have been run by a well-known English expert without any trouble. One matter, however, seems to be proved as a consequence, viz., that unless the coachmen of the future are mechanicians, all motor carriages will have to be greatly simplified. Indeed, in certain quarters, much attention is now being given to this part of the subject, and in due course we hope to see a carriage of adequate horse-power and simple in the extreme. In the meantime the public should be warned against buying a good deal of rubbish which is being offered, and we therefore suggest that any would-be purchaser should insist upon the following test before he closes a bargain: He should see the vehicle travel up and down hill for not less than 30 miles at a stretch, and at the end of this trial run it should be seen that none of the parts have become too hot. The question of whether the mechanism is of the most approved type he must naturally leave to an independent expert. There are several carriages in this country about which much fuss is being made, but which we are confident could not perform the journey mentioned, although for short runs such as can be observed at the Imperial Institute, Crystal Palace, the Hurlingham Club, &c., success seems assured. There are many easily-led people who would eagerly purchase a horseless carriage on the strength of such seemingly perfect, though utterly useless, performances.

Swallowed Her Transfer.—It was on a summit street trailer, says the *Kansas City World*, and the young mother was absent-mindedly gazing on a far off blue-capped height and carelessly toying with a pink-tinted transfer check in her right hand. The baby had asked for the pretty ticket, but the mother's thoughts were busy elsewhere. She kept on looking out over the landscape, evidently in a brown study. "Fares, please!" It was the conductor. The mother came back to the present tense with a jump. "I paid my fare once." "No, mam, you didn't, beggin your pardin." "Yes I did. I had a trans——" Just then the baby began to gag and grow black in the face. And not only black, but all about her little mouth were remarkable variegations in shades of pink. The transfer ticket had returned to the pulp from which it was made. The mother scooped out what was left of it from baby's mouth, thumped the little one's back to aid it in recovering its breath, and then turned a very red face toward the conductor in mute inquiry as to what was to be done. The conductor said never a word. He merely held out his hand. "Well, I won't pay again. I—I—I'll walk first." The conductor gave the gripman one bell. All the passengers looked their sympathy as the mother and the variegated little one left the car.

Personal.—Mr. C. H. Gadsby, having completed and put into service the Madras Electric Tramways, on behalf of the trustees for the debenture-holders and the Electric Construction Company, has returned to England and joined the staff of the British Electric Traction (Pioneer) Company, Limited, having declined a substantial offer to return to India.

We notified last week that Mr. W. Lowry had left Messrs. Mellier & Co., to join Messrs. W. Turner, Lord & Co. Mr. R. H. Cruess is now acting as electrician to Messrs. C. Mellier & Co.

Society of Chemical Industry.—Among the places visited by the members during their annual meeting last week was Messrs. Siemens Bros., Limited.

Lightning Express.—We had the pleasure early this week of inspecting a model of Mr. Behr's lightning express, but we hope to say more about it next week.

Electrocution in Ohio.—Electrocution has superseded hanging as a capital punishment in the State of Ohio.

Processes for the Nickel Plating of Wood.—The nickel plating of wood if not an important industry in this country is, at least, an interesting one, and one which in Germany at any rate has attained considerable proportions. There are so many directions in which nickel coated wood may be usefully employed, even though none of them perhaps might absorb a great quantity of the metal. In a recent issue of *Dingler's Polytechnisches Journal*, 298 (3) page 72, there is an interesting *résumé* of all the processes of nickel-plating on wood which are now being exploited. Those of our readers who are commercially interested in this phase of electroplating may usefully consult the paper in its entirety. To give an idea of the *modus operandi* observed we may make the following extract. First of all the articles which are to be plated with nickel must be coated with metal. In the processes which is most commonly employed, three solutions are made use of, namely, (A) 1½ grms. of caoutchouc slicings are dissolved in 10 grms. of carbon bisulphide, and 4 grms. of melted wax are poured into the solution; a mixture consisting of 5 grms. phosphorus in 60 grms. of carbon bisulphide, with 5 grms. of turpentine and 4 grammes of powdered asphalt is then added and the whole shaken. (B) 2 grms. of silver nitrate are dissolved in 600 grms. of water. (C) 10 grms. of chloride of gold are dissolved in 600 grms. of water. The conducting wires are attached to the article, which, after being immersed in the first solution, is allowed to dry. The second solution is poured over it, and it is kept suspended until the surface has a dark lustre, when it is rinsed with water and treated in a similar manner with the third solution. The surface has now a yellowish sheen, and the wood is sufficiently prepared for electrolytic deposition. Langbein's dry process consists in quickly pouring over the article a collodion solution of potassium iodide, diluted with an equal volume of ether-alcohol; when the layer is just about to set, the wood is laid in a weak solution of silver nitrate, light being excluded. As soon as a yellow colour appears, the wood is rinsed, exposed to sunlight, and covered with copper; it is then ready to be nickel-plated. The wood may also be treated with immersion in an ethereal solution of paraffin or wax, and when the ether has evaporated, fine graphite is powdered over them, or the wax is covered with bronze powder, and all unevenness of surface removed. When the articles are to be electrolytically coated with copper, they are placed in a bath, the composition of which varies with the current employed generally; it consists of 30 litres of 18 per cent., copper sulphate solution, and 1½ litres of 66 per cent. sulphuric acid. When a sufficient amount of copper is deposited, the articles are ground, polished, and nickel-plated in a bath composed of 500 grms. of ammonium nickelous sulphate, 50 grms. of ammonium sulphate, and 10 litres of distilled water. If the blue litmus paper be quickly reddened by this solution, the acidity is reduced to such a point by addition of ammonium chloride, that the reddening is only slowly developed.

Electric Lighting in Calcutta.—The *Indian Engineering* says: "The project so prominently announced in the Calcutta dailies is, in our humble opinion, damped by two of its points, *viz.*, *low tension* and a *single central station*, but we must leave these and other things concerning the scheme to await our protest, when we find time to draw it up and publish it. Our contemporary also remarks that it is to be hoped that the firm to whom the supply of electricity in Calcutta is entrusted will make it a point to introduce the very latest improvements in lamps. We see that M. Tesla, the well-known scientist, has invented a form of lamp that power for power gives three times the amount of illumination that is obtainable from the best pattern now in use: so that for a given amount of light required in a room, one-third of the power usually considered essential will suffice with the new lamps invented by M. Tesla. And this in an engineering paper."

Conversazione at the Institution of Civil Engineers.—A *conversazione*, lasting two nights, was held last Wednesday and Thursday to celebrate the opening of the new building of the Institution of Civil Engineers. A number of distinguished guests were present on each evening, and there was an abundance of scientific apparatus on exhibit.

The Britannia Motor.—We specially commend to the notice of our readers the speech of the chairman of the Britannia Motor Carriage Company, Limited. Never have we perused more childish prattle, and if the shareholders of that company were satisfied with its past, present, and future outlook, as put before them, they are indeed easy to please. It would not be amiss if those who have put money into this concern were to look up the back files of the ELECTRICAL REVIEW. This company, if we read the chairman's speech aright, exists solely to exploit an electric motor, but what greater value has one motor than another in these days?

International Telegraph Conference.—The International Telegraph Conference has unanimously accepted the invitation of the British Government to hold the next Conference in London.

Steam Engines.—Prof. D. S. Capper and Mr. Henry Davey have been added to the Committee appointed by the Institution of Civil Engineers to consider the question of a standard, or standards, of thermal efficiency for steam engines.

NEW COMPANIES REGISTERED.

London Light Railways Contraction Company, Limited (48,748).—This company was registered on July 13th, with a capital of £300,000 in £5 shares to enter into contracts for the construction, repairs, and maintenance of, and to construct, equip, repair, and maintain under contract, or as owners, any works whatever, including, among others, railways and other roads, or ways to be used for traction by electricity, steam bridges, subways, roads, wharves, &c. The subscribers (with one share each) are:—A. Maclean, 1, Philbeach Gardens, S.W., gentleman; M. E. Pavy, 13, Castelnon Gardens, S.W.; F. S. Streeter, 10, Addison Road, Barnes, gentleman; G. Chamberlain, 19, Hurley Street, W., gentleman; C. H. Last, The Brambles, Woodside, Wimbledon, gentleman; E. F. Green, Strafford House, Twickenham, gentleman; J. F. Paddon, 54, Narford Road, Clapton, gentleman. The number of directors is not to be less than two, nor more than five; the first are to be appointed by the subscribers; qualification £500; remuneration as the company may decide. Registered by Last and Sons, 19, Pall Mall, East, S.W.

Gloria Electrolytic Incandescent Light Company, Limited (48,779).—This company was registered on July 15th with a capital of £20,000 in £1 shares, to carry on an agreement with R. Mondos La Correspondence de l'Industrie and G. T. Broadbridge, to acquire any inventions relating to lighting or gas economising, or capable of being used for any of the purposes connected with the business, and to acquire letters patent, or foreign letters patent. The subscribers (with one share each) are:—W. Collins, 28, Culmore Road, Peckham, S.E., gentleman; H. Dawson, 777, Old Kent Road, S.E., gentleman; E. Fry, 3, Hormead Road, N.W., clerk; G. T. Woodbridge, Knolehurst, Lancaster Road, Brighton, secretary; J. Sullivan, 9, Guildford Road, South Lambeth Road, clerk; H. Lea, 75, Holloway Road, N., clerk; C. Leam, 14, Raphael Street, Rutland Gate, S.W., gentleman. The number of directors is not to be less than two nor more than seven: qualification, £200; remuneration £50 per annum each. Registered by W. Tyndale Moore, 24, Budge Row, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

West Coast of America Telegraph Company, Limited (11,933).—This company's annual return was filed on June 19th. The capital of £300,000 in £10 shares has been taken up, the full amount called, and £300,000 paid.

Electrical Appliances Syndicate, Limited (46,620).—This company's statutory return was filed on May 14th; 1,054 shares have been taken up out of a capital of £2,000 in £1 shares; 450 have been considered as paid; £1 per share has been called on 604, and £604 has been received.

Crystal Palace District Electric Supply Company, Limited (18,532).—This company's annual return was filed on May 23rd; 28,586 shares have been taken up out of a capital of £100,000 in £1 shares, and 14,166 are considered as paid; £1 per share has been called on the others, and £14,420 has been paid; 3,264 shares have been forfeited.

Electric and General Investment Company, Limited (31,506).—This company's annual return was filed on July 3rd. The capital is £200,000, in £5 shares (of which 100 are founders'); 20,000 ordinary and 100 founders' have been taken up, £1 per share has been called on the former and £5 on the latter, and £20,500 has been paid.

Cuttriss, Wallis & Co., Limited (33,857).—This company's annual return was filed on May 23rd. The capital is £10,000, in £5 shares, and 651 have been taken up, 300 have been issued as fully-paid, and £5 per share has been called on the rest, resulting in the payment of £1,755; 120 shares have been cancelled.

Cowper-Coles Galvanising Syndicate, Limited (41,223).—This company's annual return has just been filed. The capital is £2,000 in 500 "A" and 1,500 "B" shares of £1 each; all have been taken up, and 500 of each kind issued as paid; £1 per share has been called on the rest, and £1,000 has been paid.

Cruto Incandescent Lamp Agency, Limited (41,297).—This company's annual return has just been filed; 132 shares have been taken up out of a capital of £5,000 in £1 shares, and 25 have been considered as paid. The full amount has been called on the rest, £100 has been paid, and £7 is in arrears.

CITY NOTES.

The Eastern Telegraph Company.

THE Marquis of Tweeddale presided at the ordinary meeting of this company, held at Winchester House yesterday.

In his opening remarks, the CHAIRMAN made an eloquent tribute to the late Sir John Pender, the former chairman of the company. Passing on to consider the various items in the report, he referred to the considerable increase in traffic due to the activity prevailing in Australia and in South Africa, which had temporarily created additional traffic, but this latter had now resumed its ordinary condition. There was an increase in the working expenses of £1,092, which would be deemed moderate, considering the immense increase in the traffic. Repairs of cables had amounted to £33,000 as against £52,730 in the corresponding period. This decrease was accounted for by the decrease in the quantity of cable necessary to repair defective points. That item was, of course, always fluctuating. They had issued £100,000 of 4½ debenture stock at a premium of £31,908, this premium had been carried to a general reserve fund, and had more than wiped out the discount on the 4½ per cent. debenture stock raised in 1865. The issue in 1896 of a debenture stock at a premium was a striking illustration of the progress made by the company during the past 30 years. The Telegraph Conference had only just risen, and it was yet too early to say what effect their decisions would have on the company. After referring to the urgent necessity of providing an adequate reserve fund, the chairman moved the adoption of the report and accounts, which was carried.

National Telephone Company, Limited.

THE report of the directors for the half-year ended June 30th last, states that the income accrued in respect of the business of the half-year amounts to £429,680, as compared with £396,385 for the corresponding period of 1895, being an increase of £33,295. The working expenses for the half-year amount to £226,250, as compared with £207,627 for the corresponding period of 1895, being an increase of £18,622. The net result for the half-year (after deducting the Post Office royalties, amounting to £38,958), is a profit balance of £164,472, as compared with £152,321 for the corresponding period of 1895, being an increase of £12,150. The rentals carried forward for unexpired terms of running contracts amount to £438,321, as compared with £390,978 at the corresponding period of 1895, or an increase of £47,343. Out of the available balance of £136,612 shown by the net revenue account, the board will recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares; 5 per cent. per annum, less income-tax, on the third preference shares; and 5 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to transfer £35,000 to the reserve fund, and to carry forward the balance of £17,133. The sum of £248,537 has been expended upon additional exchange and private lines erected during the half-year. A not inconsiderable proportion of this outlay is attributable to the substitution of metallic circuits for single lines, and the construction of underground work in lieu of overhead wires; both these sources of expenditure having become necessary to ensure greater efficiency in the service to subscribers in the more important and crowded centres. Transfer of trunk lines to the State—in accordance with the agreement arrived at between the Post Office and the board, the trunk lines from time to time erected by the company were surrendered to the State on April 4th last in consideration, amongst other things, of the payment on the same date of their value as ascertained and fixed by experts after an elaborate and prolonged inquiry. This transfer, separating as it does the conduct of the trunk business from the working of the local exchanges in the numerous areas assigned to the company, has naturally involved some inconvenience in connection with the "through" telephone business of the country, but as the authorities of the Post Office and the officers of the company are loyally co-operating with the object of securing to the public the most efficient service possible, it is hoped that the inconvenience adverted to may be speedily terminated. Pension fund—The board have long had under consideration the advisability and necessity of establishing a pension fund for the benefit of the officers, clerks, and others in the service of the company. Such funds are now happily becoming common in the case of the large railway and other commercial companies, and are beyond doubt mutually advantageous to employers and employed. The board have had the advantage of the experience and advice of an eminent actuary familiar with the prin-

ciples and details upon which many such funds have been founded, and are now working successfully, and felt that they would have the support and sympathy of the shareholders in dealing with the matter in a generous spirit, by making the annual contribution of the company to the fund sufficient to ensure its stability, and to provide for the case of those officers and servants who, having already been in the service some years, would otherwise be placed at great disadvantage in realising the benefits of the fund in comparison with new and younger members of the staff.

Crompton & Co., Limited.

The eighth report of the directors, to be presented at the annual general meeting of the shareholders at the City Terminus Hotel, Cannon Street, in the City of London, on Monday, the 27th July, 1896, at three o'clock p.m., states that by the fire at the Chelmsford Works of the company, as reported by circular to the shareholders in November last, the offices of the company were, with the whole of their contents including all the books of account there, and drawings, utterly destroyed, and as a consequence the directors are unable to present to the shareholders the usual statement of profit and loss for the past year. The directors have thought it best to have a complete revaluation made of all the company's property and assets as at March 31st last, and the statement so prepared they now submit to the shareholders. The loss of property by the fire has been made good by the insurance companies, and the amount has been partly reinvested in similar assets, leaving a balance of £26,585, which has been placed on deposit to be applied only in restoration. The directors, owing to the growth of the business and the demand of the insurance companies that the generating station for the lighting of Chelmsford should be detached from the manufactory, have decided, after careful consideration, that it is advisable to construct new works upon a more convenient site, and they have accordingly purchased nine acres of freehold ground adjoining the railway at Chelmsford, and contracts have been let for the erection of commodious works with a siding on to the railway. The directors believe that these works, situated on the main line of railway and fitted with all modern appliances, will place the company in a far more favourable position for manufacturing economically and rapidly than it could ever have attained at the old site. The Chelmsford Electric Lighting Company, Limited, is making very satisfactory progress. The station for generating the electrical energy has hitherto formed part of the manufacturing premises of this company, and a fixed charge per unit has been made for current supplied to the Lighting Company. It is now, however, proposed that the electricity station which is being re-erected and equipped after the fire shall be sold outright to the Lighting Company, which will thenceforward carry on its own business independently. Although the insurance companies have paid for the property actually destroyed by the fire, the consequential damage to the company has been very great. Owing to the serious interruption to the business, and the greatly increased costs of manufacturing in temporary premises since the fire, a heavy loss has been incurred by the company. The statement now presented shows a balance of £10,051 0s. 11d. to the debit of the revenue account, to which must be added, £1,000 as a provision for doubtful debts; and as this loss is entirely owing to the exceptional circumstance of the fire, the directors propose to place the amount to a suspense account. It is with much pleasure the directors have to report that the order book of the company is so full that a larger number of men are employed at Chelmsford than has ever been necessary before, and the prospects for the future are most satisfactory and encouraging. The directors regret that as announced at the general meeting last year Viscount Emlyn has retired from the position of chairman of the company in consequence of his having been appointed chairman of the Great Western Railway. The board have elected Mr. John Tritter to fill the vacancy thus caused, and a resolution will be submitted confirming this appointment. In accordance with the articles of association Mr. Carleton F. Tufnell retires from the board of directors by rotation, but offers himself for re-election. The auditors, Messrs. J. H. Duncan and Co., also offer themselves for re-election.

Electrical Power Storage Company, Limited.

The ordinary general meeting was held last Thursday week at the offices, Great Winchester Street. Mr. J. Irving Courtenay, who presided, stated that the directors were able to recommend the same dividend as that which was paid in the previous year—5 per cent. Full provision had been made for maintaining their buildings and plant. The quantity of their manufactures sold during the year showed an increase, in spite of the keen competition. It had given them much pleasure to have M. Camille A. Faure, to whose brilliant invention in 1881 secondary batteries owed their commercial existence, associated with this company's manager, Mr. Frank King, with the result that, after long and exhaustive experiments in the company's laboratory, extending over a year and a half, a reduction in weight in the battery of over 40 per cent., and a reduction in space of 45 per cent. had been achieved, and this without any sacrifice of stability. The importance of these improvements in connection especially with autocars, tramcars, and self-propelled vehicles generally, could not be overstated, and they had just come when most wanted by engineers and the public. He had read with some surprise the statement in a report of the committee of the Glasgow Corporation that the combined system of the overhead trolley and accumulators which had been installed at Hanover, in Germany, was in their opinion objectionable. In consequence of this statement, he had taken some pains to get official information, and he had found that the results of the installation were so favourable that the directors of the Hanover Street Tramways had resolved to increase very considerably the size of the installation. The installation generally appeared to have given every satisfaction, and had fulfilled all the claims made upon it; and it was important to notice that the financial results as regarded the maintenance of accumulators had been exceedingly satisfactory. Moreover, the local authority, which in this case was the police authority, confirmed the great superiority of the arrangement of accumulator traction in the town of Hanover over any other system of electric traction. He concluded by moving the adoption of the report, and the payment of the dividend mentioned.

Sir Daniel Cooper seconded the motion, which was unanimously adopted.

The Globe Telegraph and Trust Company, Limited.

The report of the directors to be presented at the meeting to be held next Tuesday states that the balance-sheet and accounts for the year ended July 18th, 1896, with statement of the stocks and shares held by the company at that date, are herewith submitted. The net revenue of the company for the year, after deduction of expenses, amounts to £185,222 19s. 2d., and makes, with the balance of £1,238 3s. 4d. brought forward, a total of £186,461 2s. 6d. From this amount there has been distributed the sum of £125,614 0s. 9d. in interim dividends, leaving an available balance of £60,847 1s. 9d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. 9d. per share on the ordinary shares, making, with previous distributions, a total dividend for the year of 6 per cent., less income-tax, upon the preference, and 4½ per cent. net (against 4½ per cent. for the preceding year) upon the ordinary shares, leaving a balance of £948 8s. 8d. to be carried forward to the next account. The directors have deemed it advisable, in future, to pay the interim dividends on October 31st, January 31st, and April 30th in each year; the date of the final dividend remaining unchanged. Since the last meeting the remainder of the money resulting from the paying off of the Direct Spanish Telegraph Company's 6 per cent. debentures has been re-invested. The directors deeply regret having to report the death, on 7th inst., of their colleague Sir John Pender, who had been chairman of the company from the time of its inception, and to whose remarkable energy and business capacity so much of the success of this company has been due. The directors have appointed as chairman the Marquis of Tweeddale, who has been a director from the formation of the company. In conformity with the articles of association, two of the directors, viz., James Pender, Esq., M.P., and Lord Sackville A. Cecil, retire, and being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Mr. William Griffith, B.A., Barrister-at-Law, also retire, and offer themselves for re-election.

Anglo-American Telegraph Company, Limited.

The report of the directors to be presented at the ordinary general half-yearly meeting of the proprietors, to be held at Winchester House, 50, Old Broad Street, London, to-day, states that the total receipts from January 1st to June 30th, 1896, including the balance of £794 0s. 11d. brought forward from the last account, amounted to £154,832 4s. 8d. The traffic receipts show an increase of £11,917, as compared with the corresponding period of last year. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £57,028 19s. 5d., being an increase of £1,644 17s. 1d. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £85,803 5s. 3d. One quarterly interim dividend of 12s. per cent. on the ordinary stock, and of £1 4s. per cent. on the preferred stock, was paid on May 1st, 1896, absorbing £42,000, and a second quarterly dividend of 12s. per cent. on the ordinary stock, and £1 4s. per cent. on the preferred stock, amounting to £42,000, will be paid on August 1st, 1896, leaving a balance of £1,803 5s. 3d. to be carried forward to the next account. The company's repairing ss. *Minia* has been employed during the past half-year in the repair of several of the cables connecting Newfoundland with Cape Breton. She has also been employed by the Direct United States Cable Company for the repair of a cable belonging to that company, the payment for which appears in the revenue account.

The Direct United States Cable Company, Limited.

The report of the directors for the six months ended June 30th, 1896, to be presented at the 38th ordinary general meeting of the company, to be held at Winchester House (Hall No. 174), 50, Old Broad Street, in the City of London, on Tuesday, July 28th, at 2.30 o'clock p.m., states that the half-year's revenue, after deducting out-payments, amounted to £42,456 11s. 9d. as compared with £37,653 2s. 4d. for the corresponding period of 1895, being a difference of £4,803 9s. 5d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £19,692 4s. 2d., leaving a balance of £22,764 7s. 7d. as the net profit of the half-year, making with £4,148 14s. 4d. brought forward from the previous half-year a total of £26,913 1s. 11d. For the corresponding period of 1895, the working expenses and other payments amounted to £18,909 0s. 10d. Three quarterly interim dividends amounting to £19,730 15s. have been declared and paid during the financial year, and a final payment of 2s. 6d. per share is now proposed, making, with the three interim dividends, 2½ per cent. for the year, being a total distribution of £27,319 10s. After transferring £7,500 to the reserve fund account, the balance of £4,235 11s. 11d., on the

revenue account is proposed to be carried forward. The directors record with profound regret the death of their highly esteemed colleague and late chairman, Sir John Pender, G.C.M.G., which occurred at Foots Cray Place on the 7th inst. Sir John Pender had occupied the chair of the company from the date of its incorporation in 1877 until early in the present year, when the precarious state of his health compelled him to retire from that position. The directors thereupon invited Mr. E. M. Underdown, Q.C., to assume the office of chairman, which he accepted. The vacancy in the board, created by the death of Mr. Charles Meara in 1894, has been filled by the appointment of Mr. John Varley, one of the largest shareholders in the company. The cable repairs in progress in December last, as announced in the last half-year's report, were satisfactorily completed early in January at a further cost, including new cable inserted, of £8,243 17s. 1d., which has been debited to the reserve fund account, the balance of which, with the addition of interest, realised profit, and amount transferred from revenue account now stands at £313,969 4s. 1d. The interests of the company are being represented at the International Telegraphic Conference now sitting at Buda Pesth. Pursuant to the provisions of the articles of association, two of the directors, viz., John Varley, Esq., and E. M. Underdown, Esq., Q.C., retire by rotation, and, being eligible, offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. J. & J. Sawyer & Co., the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

City and South London Railway Company, Limited.

THE report of the directors, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, in the City of London, on Tuesday, July 28th, 1896, at 12 o'clock noon, states that the receipts from all sources for the past half-year have amounted to £24,910 18s. 9d., and the cost of working has been £15,001 17s. 10d., leaving a profit of £9,909 0s. 11d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £11,158 5s. 2d. After making provision for the debenture and debenture stock interest, a balance remains available for dividend of £7,499 1s. 8d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 1⅝ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £1,072 5s. 6d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year ended	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).		
		£	s.	d.
December 31st, 1890 (11 days)...	165,000	1,568	3	9
June 30th, 1891	2,412,343	19,403	6	9
December 31st, 1891	2,749,055	19,798	16	6
June 30th, 1892	2,813,162	20,931	4	2
December 31st, 1892	3,117,602	22,002	17	5
June 30th, 1893	3,146,656	22,458	6	9
December 31st, 1893	3,093,351	22,067	14	10
June 30th, 1894	3,383,154	23,564	10	6
December 31st, 1894	3,275,649	23,540	12	4
June 30th, 1895	3,113,199	23,711	5	8
December 31st, 1895	3,172,438	23,780	3	7
June 30th, 1896	3,192,672	24,021	13	0
Total since opening of the line	33,634,281	£246,848	15	3

The exceptionally mild winter, and the extremely fine weather since experienced have, there can be no doubt, militated against the traffic of the line, and it is satisfactory that, in spite of these adverse conditions, the returns for the half-year show an increase, both in the number of passengers carried, and in the amount of receipts. The alterations at the City Station have proved, as was anticipated, of considerable advantage in coping with the traffic in the busy hours of the day. The new coaches, and the locomotive constructed in the company's own shops, are now in use with satisfactory results. The generating plant, locomotives, and rolling stock have been well maintained, and are in good working order and efficiency. During the half-year a further sum of £8,400 5 per cent. terminable mortgage bonds has been paid off. The erection of the condensing plant is now proceeding rapidly. This work has been somewhat delayed through the anxiety of your directors to avail themselves of the latest improvements, with the view of obtaining as perfect an apparatus as possible. Active steps are now in progress for the acquisition of the sites required for the stations at London Bridge and Finsbury Pavement, and tenders have been invited for the construction of the works. Acting under the authority given by the proprietors at the last half-yearly meeting, the 20,000 5 per cent. perpetual preference shares then authorised have all been placed at a considerable premium, it being stipulated that no dividend shall accrue upon those shares until after January 1st, 1899, by which time it is expected the extension will be finished and open for traffic. The Bill for the extension of time for the completion of the works authorised by the Company's Act, 1893 (Islington Extensions), has been considerably delayed owing to the opposition to the powers granted by the original Act for the acquisition of the site of St. Mary Woolnoth Church. In the first instance, the rector and churchwardens of that church desired that the building should not be removed, and upon their opposition the House of Commons Committee inserted a clause in the Bill for the preservation of the fabric of the church, but when the Bill came before the Committee of the House of Lords, the rector and churchwardens informed that Committee that, under the circumstances, they preferred that the church should be pulled down, and the Committee thereupon struck out the clause inserted in the Commons. It is hoped that the Bill will now meet with no further opposition during its remaining stages.

Britannia Motor Carriage Company, Limited.

THE statutory general meeting of the shareholders of the Britannia Motor Carriage Company, Limited, was held on Monday at Winchester House, Old Broad Street, the Hon. J. H. H. Berkeley presiding.

The CHAIRMAN said: This is the statutory meeting which every limited company is compelled by the Companies' Acts to hold within four months of its incorporation, and as this company was registered on March 24th, the meeting had to be held about this date. The provision for a statutory meeting being held at such an early date is, no doubt, a very good one in many cases, but it has this disadvantage, that when a company has been registered some time previous to allotment (which is frequently necessary, either for the purpose of securing the name of the company or for some other good reason) it prevents the directors being able to tell their shareholders very much, as the time which elapses between the allotment and the date of the meeting is necessarily very short. After our allotment on June 9th it took some time to get all the necessary legal and other details arranged for the transfer of the patent, &c., to the company, and consequently we cannot tell you very much more to-day than was told in our prospectus, and you will understand that it was not desirable that your directors should launch out into any large undertakings until all these preliminaries were satisfactorily settled, besides which, in the present state of the law regarding motor traffic, it would not be desirable to undertake heavy obligations until the Bill now before Parliament has become an accomplished fact. There is every reason to believe it will be passed during this session, but until then it is more prudent to go slowly. For the reasons I have first mentioned, we did not give an earlier public exhibition of our motor carriages than on the 15th inst., although the motors could have been seen at work at the premises of Messrs. John Ward and Co., 246, Tottenham Court Road. On that evening a number of gentlemen of the press and others interested in the motor car industry were invited to see a practical display of our motor, which earlier in the afternoon had been shown to and much appreciated by the members of the Automobile Clubs of France and Belgium, and I am sure you will be pleased to learn that these experts expressed a very high opinion of the motor. Rather bad luck attended the evening show. Our motor carriage went most admirably for some time, but while running at the rate of 10 miles an hour it ran right into a Daimler motor carriage which stopped suddenly just in front of it, and its steering gear being disarranged, on being started again it ran into the embankment, and the front of the carriage was severely damaged and it had to be stopped. All who saw it and who drove in it gave expression to their appreciation, and especially noticed the absence of any vibration, as well as absence of heat, smell, smoke, steam or noise. You have no doubt many of you seen reports of the trial in some of the papers. Now, I should like to dispel some misapprehensions which have arisen with regard to our motor, and also to reply very shortly to some criticisms which have appeared about us. We have no objection whatever to criticism—in fact, we rather invite fair legitimate criticism—but I am afraid that some of the criticisms to which we have been subject have arisen from a not altogether clear apprehension of our objects. The point about which we have been most taken to task was the omission from our prospectus that our motor was driven by electricity, and some of our critics have even gone so far as to say this was done purposely. When the prospectus was issued, there was sent with it drawings and diagrams showing the carriage and motor. It certainly never occurred to us that at the end of the nineteenth century there was anyone who could suppose that there was such a thing as a motor which could engender force of itself, and that being so, it seemed to us it must be apparent to anyone really studying the prospectus that this motor could be driven by nothing else but electricity. The only motors known to me are water, steam, oil, benzine, spring, and electricity. Well, it was quite certain that our motors could not be driven by water, as we could not carry a running stream in our carriage, and as the prospectus stated that it had no heat, smoke, smell or steam, it was very evident that it would not be driven by either gas, steam, oil or benzine. It was certainly not likely to be a spring, and therefore I think that we may conclude that any intelligent investor, seeing that it would not be driven by any of these powers, and understanding there is no such thing as perpetual motion, would know that there was only one other power available, namely, electricity. Gentlemen, the idea of wilful omission is at once dispelled by the fact that when issuing the prospectus we stated in it that our motor could be seen attached to a carriage in Tottenham Court Road, and investors were invited to visit it, and, as a matter of fact, some two or three thousand people did go and see it, and a good many of them, having seen, believed, and became subscribers; indeed, the large majority of those to whom shares have been allotted had seen the motor, and knew all about it. Then exception was taken that no reference was made that a battery would be necessary, and that a battery would add very considerably to the weight. Well, we were only advertising a motor, we had nothing to do with advertising a battery. We were pledged to no particular sort of battery, our intention being to use any battery

which was most suitable for our motor, for we claim it can be driven equally well either with a secondary or primary battery, and in some instances no battery would be required—such as when the motor is on a tramcar, for stationary work. Then as to the additional great weight, most of you have probably ridden in a "'bus," and if you have been inside, you have seen this legend written up, "This vehicle is licensed to carry 26 passengers—12 inside and 14 out," and if you add the driver and conductor there will be 28 persons. The average weight of these 28 persons would be, I presume, 11 stone each, which would mean about 4,312 lbs. I am told the weight of an omnibus is about 30 cwts., then adding the weight we had before, it means about 7,600 lbs. Well, we see two horses drawing with comparative ease this weight. Now, the Victoria, to which we have fitted a two horse-power motor, weighs about 4½ cwts.; if we add this to the weight of the motor, about 100 lbs., and the additional weight of the battery, which our expert says is not, for the horse-power employed, more than 5,181 lbs., you will find what our two horse-power motor is asked to do is about one-fifth of what the omnibus horses do in London, therefore our omission in stating that a battery would have to be employed was not of very material importance. Then another criticism was that this motor would constantly require to be recharged, and the accumulators could not be charged in country places. All I have to say is that it does not matter what power you employ, that power has to be recuperated or recharged; if horses are employed they have to be fed and rested; if boilers are used, coal or gas, or benzine, and so with an electric motor, it has to be recharged. Anyone living in a country place where there was not a supply of electricity would not use an accumulator, but a primary battery, which, I have already said, is quite as applicable to our motor. Then some say: "Oh, yes; we must come to carriages driven by motors, and no doubt electric motors will be employed, but the matter is in the experimental stage, and yours may not be the best." Well, the answer to this kind of criticism is that if Stephenson had waited until he could get a train of cars fitted as we see them to-day, capable of running 80 miles an hour over an extended time, and if those who first put on an Atlantic steamer had waited for the present magnificent steamers, doing the journey in little under five days, the wealth and commerce of Great Britain would not be anything like what it is. Or, to make use of an example near home, if Mr. H. J. Lawson, the inventor of the first safety bicycle, had waited until these machines had reached their present state of perfection to give the world the benefit of his invention, that revolution in the road traffic which has taken place would never have occurred; so I hope it will be with us, and our enterprise may be rewarded. And, gentlemen, I must ask you to remember that anyone who applies for shares in a company exploiting a patent must be aware that he is dealing in a speculative company. We have had many offers for our motor from those who have seen and know it is driven by electricity, from every part of England. From one well-known seaside town alone we have an offer to take a very large number. These are offers and orders from hard-headed business men, who, having seen the motor, believe it can be put to practical use in competition with other motors that are being offered. Then with regard to patents other than the English patents, we have had proposals for the whole of the European patents, for the American and Australian patents; and when I tell you that one of these proposals is from such well-known names in connection with autocars as Messieurs Delmer, Serpollet, de la Valette, Verne, &c., you will know the value. These offers, again, are from a class of people who certainly know what they are about, and certainly know the value of the patent for which they are making an offer. I should like to mention one other matter to show you that your directors took as much care as they could about the prospectus—it is that every statement of fact which they could not verify of themselves, they took care to have verified by a statutory declaration as to its correctness. I do not know what more could have been done than this. Gentlemen, one of the objects of these statutory meetings is, that the shareholders may meet and know their directors. Among our directors are Mr. Bryant, manager of Morgan and Co.; Mr. Philipson, of Messrs. Atkinson & Philipson, of Newcastle; Mr. Ashton, of John Ward & Co.; and Mr. Bastian, late engineer to the Hampstead Vestry. They have all satisfied themselves, after due investigation, that our motor is suitable for carriages, and I think this is a very good proof that we shall have expert advice on the adaptation of carriages to suit our motor, and it should argue well for the management of your company that you have on the directorate gentlemen who have so managed their own business as to make them very successful. We do not for one moment say that ours is the only motor; what we do say is, we have what we believe is a really good motor, and one which is absolutely free from heat, smell, smoke or steam, and when fitted to the carriage it will be practically noiseless and absolutely non-vibrating.

The motion was duly seconded and agreed to.

A Shareholder: What type of primary battery can be used at anything like a reasonable cost and trouble? Also, how long will the carriage continue to run with 2 horse-power? I should like further to know if the shares have any market value?

The Chairman: As to the value of the shares, I take it that the gentleman holds a number of shares for which he paid £1. I presume he would not have paid £1 unless he had thought they were worth that. I take it the shares are worth par, and probably more, taking into account what the future of the company is likely to be with regard to the foreign patents. As to primary batteries, I may say that at the present moment we have a primary battery offered to us which, if it fulfils all it is said to do, will answer every expectation. I do not think it would be desirable at the present moment to disclose any of the negotiations. It is stated here that the secondary battery would run from 60 to 100 miles. The inventor, Mr. Sherrin, has made a statutory declaration that with a battery and motor such as we have had, he went 64 miles. I have to thank you on behalf of the board for your vote of confidence.

India-Rubber, Gutta Percha, and Telegraph Works Company, Limited.

An extraordinary general meeting of this company was held on Monday at Cannon Street Hotel, for the purpose of making certain alterations in the articles of association. Mr. Matthew Gray, who presided, moved that articles 101, 102, and 103 be struck out, and that articles be substituted for them providing that at the ordinary meeting in every year the directors shall lay before the company a profit and loss account and a balance-sheet containing a summary of the property and liabilities of the company, &c. Mr. S. W. Silver seconded the motion. Mr. Cochrane objected to the resolution on the ground that the existing articles made it compulsory on the directors to furnish the shareholders with fuller information in the accounts than they would have to give under the new articles. He complained that for 20 years the accounts had not been made out in accordance with the articles, and asked on what ground the auditors suggested the proposed alterations. Mr. Clarke (Messrs. Turquand, Youngs and Co.) stated that personally he had audited the company's accounts for only three years. He drew attention some time ago to the fact that the accounts were not quite in accordance with the articles, but it was considered that the words "as near thereto as circumstances admit" covered the case. As the result of further consideration, however, and on its being explained to him that to give the full details required by the articles would be prejudicial to the company, he suggested that the articles should be altered as now proposed. He did not think for a moment that any objection would be raised to the proposals. The chairman having pointed out that it was necessary to make the suggested alterations in the articles in order to prevent competing companies from obtaining information about this company's business which it was desirable to keep secret, the resolution was carried with one dissentient. Several other alterations in the articles of minor importance were also agreed to.

Telegraph Construction and Maintenance Company, Limited.

A meeting of this company was held on Monday at the offices, 38, Old Broad Street, Admiral Sir G. H. Richards presiding.

The Chairman, after referring to the great loss all interested in ocean telegraphy had sustained by the death of Sir John Pender, who was the first chairman of this company, said that they had no official business to transact on that occasion, nor had the directors any accounts to place before them. Although they had not carried out any large contracts so far this year, they had received orders from various companies and Governments for several hundreds of miles of cable, a good deal of which had been completed. But perhaps the most important operations they had performed had been the repairing of different cables, all of which had been successfully accomplished. The principal of these had been the repairs to the French Telegraph Company's cable between Brest and New York. Although the board were desirous of giving all the information they could to the shareholders, they felt that it would be unwise to allude to any contracts of which they were not absolutely in possession. Experience had shown them that there were always delays and disappointments in matters of this kind from causes over which they had no control, especially when dealing with foreign countries. They were proposing to pay the usual interim dividend of 12s. per share, being at the rate of 10 per cent. per annum.

The Edison & Swan United Electric Light Company, Limited.—The directors have recommended the payment of a dividend in respect of the six months ending June 30th, 1896, at the rate of 5 per cent. per annum on the "A" share capital of the company as now paid up, carrying forward about £5,000 as against £3,700 in the previous year. The above distribution, together with the interim dividend at the same rate already paid in February in respect of the first half year, will be equal to a dividend of 5 per cent. for the entire year.

The Charing Cross and Strand Electricity Supply Company, Limited.—To provide for the erection of a new station at 85, Commercial Road, this company is issuing 10,000 4½ preference shares of £5 each at par. The list opened and closed on Wednesday.

The Kensington and Knightsbridge Electric Lighting Company, Limited.—An interim dividend at the rate of 6 per cent. has been declared for the past half-year on the ordinary shares of this company, payable on August 1st.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 19th, 1896, were £857; week ending July 21st, 1895, £831; increase, £26; total receipts for half-year, 1896, £2,675; corresponding period, 1895, £2,594; increase, £81.

The Liverpool Overhead Railway Company. The receipts for the week ending July 19th, 1896, amounted to £1,267; corresponding week last year, £1,226; increase, £41.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 17th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,762

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, July 15th.	Closing Quotation, July 22nd.	Business done during week ended July 22nd, 1896. Highest.	Lowest
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104 xd	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	9 — 10	9 — 10	9⅛	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	50 — 52 xd	50 — 52	50½	50
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	93½ — 94½xd	94½ — 95½	95½	93¾
2,993,560*l*	Do. do. Defd.	Stock	...	...	...	9 — 9¼	9 — 9½	9⅝	...
130,000	Brasilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	15 — 15½	15¼ — 15¾	15½	15⅜
75,000*l*	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	5 %	111 —115	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3¼ — 3⅜	3½ — 4	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	1/16 — 1/8	1/16 — 1/8 xd	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½	12½ — 13½	...	...
5,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20 — 21	20 — 21	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½ — 4½	3½ — 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000*l*	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106 —109%	107 —110 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	2¼%	9⅜ — 10¼	9⅜ — 10¼	9⅞	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	6½%	17¼ — 17¾	17⅜ — 18¼	18	17½
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	18½ — 19	18½ — 19	19	18⅞
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,297,837*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	131 —134	131 —134	133	132
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½ — 18	17⅜ — 18¼	18¼	17⅜
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	132 —135	132 —135	133	...
80,600*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	100 —104	100 —104	...	...
107,600*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	111 —114 %	111 —114 %	111⅜	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	4½%	11 — 11½	11 — 11½	11⅜	11½
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17½ — 18	17⅜ — 18¼	18	17⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	8⅝%	10 %	23½ — 24½	23¾ — 24½	24	...
180,000*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	53 — 56	53 — 55	...	...
100,000*l*	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	111 —114	111 —114	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2¼	2 — 2⅜	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	7⅝ — 7⅞	7⅝ — 7⅞	7 13/16	7⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16 — 17	16 — 17	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅞ — 7⅛	6⅞ — 7⅛	...	...
1,100,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —108	107 —110	108½	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	⅜ — ⅞	⅜ — ⅞	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	106 — 109	108 —111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	135 —140	137 —142	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3⅜ — 4¼xd	3⅜ — 4½	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	101 —106	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	7 — 8	6 — 7	...	...
238,300*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	104 —107	105½	104
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	1 — 2	1 — 2	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	98 —103	99 — 104	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	8⅜ — 9¼	8⅜ — 9¼	...	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6⅜ — 7¼	6⅜ — 7¼	...	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	2¼ — 2⅜	2¼ — 2⅜	...	...
165,200*l*	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	6 %	105 —109	105 —109	...	...
206,400*l*	Do. do. do. do "B," do.	100	6 %	6 %	6 %	105 —109	105 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	1⅛%	⅞%	1⅛ — 1⅜	1⅛ — 1⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11¼ — 11¾	11½ — 12	11⅝	11½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½ — 10½	9½ — 10½	10⅜	9⅝
80,000*l*	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	107 —110	108 —111	110	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	110 —115	...	...
164,300*l*	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —105	104 —107	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	8¼ — 8⅜	8¼ — 8⅜	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7⅜ — 8¼	7⅜ — 8¼	8¼	7¾
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	114 —116 xd	114 —116	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½ — 15½	14½ — 15½	15½	15
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16⅜ — 17¼	16½ — 17xd	17	16 15/16
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	133 —137	133 —137	136	134½
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8½ — 9½	8½ — 9½	9	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	13 — 13½xd	13½ — 13⅝	13⅝	13 5/16
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2½%	3 %	4 %	12½ — 13½	13½ — 14	13⅝	13 5/16
100,000*l*	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 —121 xd	119 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	10 — 10½	10½ — 11½	10½	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	11½ — 12½	12 — 13	12 5/16	12
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½ — 10½	9½ — 10½	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —106	104 —106	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 50,000 ...	5	4 %	5 %	7 %	10½ — 11	11 — 12	12	11

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, July 15th.	Closing Quotation July 22nd.	Business done during week ended July 22nd, 1896. Highest.	Lowest
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000	3	5 % §	2½%	...	1½ — 1⅝	1 — 1½	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅝ — 1⅝	1⅜ — 1⅝	1⅜	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	4½%	...	112 —115	112 —115	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	... — ...	98 —102	100	...
630,000£	City and South London Railway	Stock	1¼%	1¼%	1⅛%	44 — 46	45 — 47	46½	45½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	*nil*	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1¾ — 2¼	1¾ — 2¼	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	3	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1½ — 1½	1⅝ — 1⅝	1⅝	1 9/16
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½ — 3	2½ — 3	2¾	2⅝
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅜ — ⅞	⅜ — ⅞	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅜ — ⅞	⅜ — ⅞	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	10½%	10½ — 11½	10½ — 11½	...	
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17½ — 18½	17½ — 18½	18½	17⅞
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	17 — 18	17½ — 18½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	21 — 23	21 — 23	22	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	108	107½
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅞%	13⅞ — 14	13 15/16 — 14 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	17⅛ — 17⅜	17⅛ — 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	37 — 40	37 — 40	39¾	39½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105xd	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	8 — 8½	8 — 8½	8¼	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—5%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.
Electric Construction Corporation, 6 % Debentures, 103—105.
House-to-House Company (£5 paid), 4—4¼.
Do. do. 7 % Preference, of £5, 8⅛—8⅜.
Do. do. 4½% Debentures of £100, 108–110.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 9¼—9⅜; 1st Preference Cumulative 6 %, £5 (fully paid), 7½—8.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7¼—7⅜.

Bank rate of discount 2 per cent. (February 22nd, 1894).

ALTERNATE CURRENT MOTORS.

By W. G. RHODES, M.Sc.,
City and Guilds of London Institute. Central Technical College.

(*Concluded from page* 142, *Vol.* 38.)

In our last article we deduced that the starting torque in an induction motor is a maximum for variations of the resistance of the rotor coils when $r_1 = s_1$, or when the resistance and reactance of the rotor coils are equal. If, however, the resistance is fixed, the expression

$$T_0 = \frac{n_1^2 e^2 r_1}{m (r_1^2 + s_1^2)}$$

shows that the starting torque is made as large as possible by placing the rotor coils so as to make their *reactance as small as possible.*

The next point to consider in designing an induction motor is the magnitudes of the currents in stator and rotor at starting.

The primary current was found to be

$$= - k n_0 e \left(\frac{Y}{k} + \frac{1}{a^2 I_1} \right)$$

Neglecting Y and putting $k = 1$, the primary current at starting is approximately

$$- \frac{n_0 e}{a^2 I_1} \text{ or } - \frac{n_1^2}{n_0} \frac{e}{\sqrt{r_1^2 + s_1^2}}$$

Similarly the secondary current at starting is approximately

$$\frac{n_1 e}{\sqrt{r_1^2 + s_1^2}}$$

The primary and secondary currents at starting, therefore, increase as the reactance of the rotor coils diminishes. To make the starting currents small, the reactance, s_1, must be large.

The conditions of large torque and small currents at starting are thus seen to be antagonistic. The best course to pursue in designing an induction motor is to fix the starting torque, and then the coils in the stator and rotor can be taken of such a cross section as safely to stand their respective currents at starting. The currents can be calculated from the equations

$$\text{Primary current at start} = \frac{m T_0}{r_1 n_0 e}$$

$$\text{Secondary current at start} = \frac{m T_0}{r_1 n_1 e}.$$

In other respects the design of an induction motor is similar to that of an ordinary stationary transformer.

Methods of Winding the Stator Coils in an Induction Motor.

We mentioned in a previous article that the stator coils might be wound in either a *star* or *mesh* manner, and sometimes a combination of the two. It will be sufficient to consider the stator windings of a tri-phase motor. The reader may work out other cases for himself.

In the star winding the stator coils have a common junction from which they branch off to their respective lines. An inspection of fig. 24 will make this clearer. The stator coils, *a*, *b*, and *c*, have a common junction, O, and are joined respectively to the mains, A, B, and C. If the voltage at the terminals of the coil, *a*, is $e \sin \delta$, the pressures at the terminals of *b* and *c* will be $e \sin \left(\delta - \frac{2\pi}{3}\right)$ and $e \sin \left(\delta - \frac{4\pi}{3}\right)$ respectively.

The difference of potential between A and B will therefore be $e \sin \delta - e \sin \left(\delta - \frac{2\pi}{3}\right)$, or $\sqrt{3}\, e \sin \left(\delta + \frac{\pi}{6}\right)$, which is in advance of the pressure in *a* by an angle, $\frac{\pi}{6}$. Similarly the potential difference between B and C is $\sqrt{3}$ times the

E.M.F. in b or c, and is 30 degrees in advance of the E.M.F. at the terminals of b.

To put this in another way, suppose that the machine is a generator; then if the E.M.F. generated by each of the coils, a, b, c, be e, the potential difference between any two of the mains would be $\sqrt{3} \cdot e$.

The currents in a, b, c are respectively the same as those in A, B, and C.

If the coils are wound in the mesh fashion (fig. 25), the potential difference between A and C is obviously the same as the E.M.F. in a. The current in a will not now be the same as that in A. Let the currents in a, b, and c be $i \sin \delta$, $i \sin \left(\delta - \frac{2\pi}{3}\right)$, and $i \sin \left(\delta - \frac{4\pi}{3}\right)$ respectively: then

$$\text{current in A} = i \sin \delta - i \sin \left(\delta - \frac{2\pi}{3}\right)$$

$$= \sqrt{3} \cdot i \sin \left(\delta + \frac{\pi}{6}\right)$$

and so on.

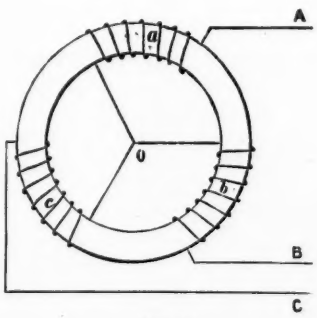


FIG. 24.

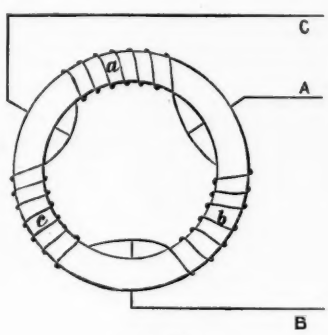


FIG. 25.

That is, in the mesh winding, the currents in the mains are $\sqrt{3}$ times the currents in the stator coils.

It is worthy of notice that whether the windings of the stator coils be *star* or *mesh*, the power absorbed is the same, and equals $\sqrt{3}$ times the product of the current in one of the mains and the potential difference between any two mains.

The star winding possesses an advantage over the mesh winding inasmuch as the actual potential of the common junction O is of no consequence, and the point may be earthed without altering in any way the working of the system.

A combination of the star and mesh windings was introduced by Dobrowolsky with a view to obtain a more uniform torque than could be attained by either system separately.

MONOPHASE INDUCTION MOTORS.

In the induction motors already described, the torque at any instant is due to the fact that the angular velocity of the magnetic field, due to the stator windings, differs from that of the rotor: and, since the difference between these angular velocities is greatest when the rotor is at rest, the greatest torque on the rotor is at starting.

It would obviously simplify matters if a non-synchronous motor could be made for use on single-phase circuits. Various attempts have been made to produce monophase non-synchronous motors, but as yet no one has succeeded in producing one which is self-starting.

Suppose that in an induction motor the stator coils form a single circuit fed by a single alternating current, while the rotor is exactly the same as in a diphase or triphase motor, the resultant magnetic field would preserve a constant direction and would simply alternate in sense as in a stationary transformer, so that if the rotor is at rest the currents induced in the rotor coils are of such a nature that no torque is produced, but if the rotor is started in either direction, a considerable torque is produced, and the speed will increase, and the rotor will tend to run synchronously with the magnetic field. To see this more clearly we may replace the stationary alternating magnetic field by two rotary fields of equal strength, but revolving with the same angular velocity in opposite directions; for it is known that any simple harmonic motion is equivalent to two equal and opposite uniform circular motions.

If the rotor is started by some means in either direction, the induced currents may be regarded as the algebraic sum of the currents due to cutting these two rotary fields. The "slip" in the two cases will differ, but we have already proved that torque varies with the slip, therefore there will be a resultant torque acting on the rotor tending to increase

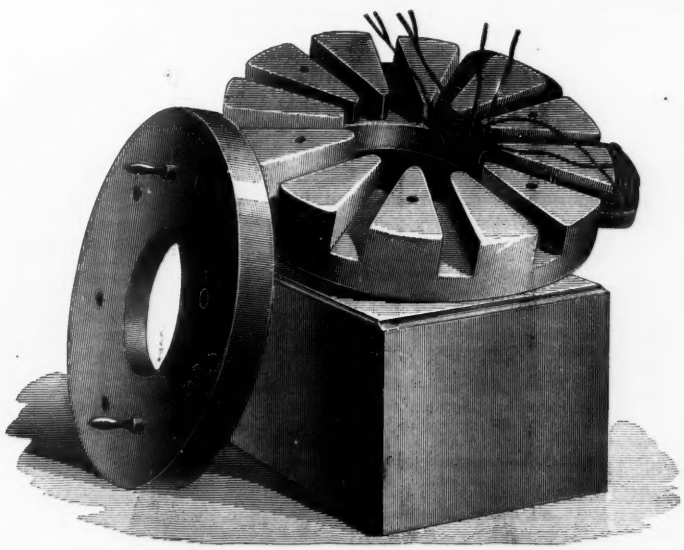


FIG. 26.

its speed. Let the two slips be k_1 and k_2 respectively, and let r and s be respectively the resistance and self-induction of the rotor coils. If T_1 and T_2 are the torques corresponding to slips k_1 and k_2, we have

$$T_1 = \frac{A\, k_1\, r}{r^2 + k_1^2\, s^2}$$

and

$$T_2 = \frac{A\, k_2\, r}{r^2 + k_2^2\, s^2}$$

where A is a constant for a given induction, therefore,

$$T_1 - T_2 = \frac{A\, k_1\, r}{r^2 + k_1^2\, s^2} - \frac{A\, k_2\, r}{r^2 + k_2^2\, s^2}$$

$$= \frac{A\, r\, (k_2 - k_1)\, (k_1\, k_2\, s^2 - r^2)}{(r^2 + k_1^2\, s^2)\, (r^2 + k_2^2\, s^2)}$$

Suppose that k_2 is greater than k_1, that is, the rotor is started in the direction of k_1; then $T_1 - T_2$ is positive provided,

$$k_1\, k_2\, s^2 - r^2 \text{ is positive,}$$

and this is made to be so by having the rotor coils made of stout copper rods short circuited, so that s is large compared with r.

If, then, the rotor is set in motion, there will be a resultant torque tending to increase the motion, but if the rotor is at rest, or $k_1 = k_2$, the resultant torque is zero.

The difficulty then with these monophase induction motors is, that they are not self-starting; but they are not so difficult

to start as synchronous motors, for they need not be run up to synchronism, and it is not necessary to have an auxiliary source of power to effect the starting.

The way in which monophase induction motors are usually started is by having additional stator windings round which flows a currrent out of phase with the main current. It is not necessary to have an additional source with which to supply these additional windings with current ; they may be arranged in parallel with the main windings on the stator, so that the main current divides, part going round the main stator coils and part round the additional coils. If the ratio of self-induction to resistance of the two stator windings is different, the currents in the two circuits will differ in phase, and by making the difference of phase sufficiently large, a considerable starting torque will result.

Some makers effect the phase difference in the stator windings by making the self-induction of one circuit large and introducing capacity into the other circuit. The best condensers for this purpose are electrolytic and made of iron plates and carbonate of soda in solution.

The splitting of the main current causes the magnetic field to rotate, and the motor starts as a di-phase induction motor. As soon as the rotor is run up to a certain speed, which may be considerably below synchronism, the additional stator circuit is broken, and as now there is a considerable torque exerted on the rotor, the machine will continue to run, and will be able to give out power with a high degree of efficiency.

Construction of Induction Motors.

We do not propose to enter into the mechanical details of the construction of induction motors, but shall content ourselves with giving the electrical principles underlying their structure.

It has been shown (see last article, page 141), that the torque is given by

$$T = \frac{k\, n_1^2\, e^2\, r_1}{m\,(r_1^2 + k^2 s_1^2)} \qquad (\alpha)$$

Also the secondary current is given by

$$i_1 = \frac{k\, n_1\, e}{\sqrt{(r_1^2 + k^2 s_1^2)}} \qquad (\beta)$$

therefore

$$T = \frac{r_1}{k\, m}\, i_1 \qquad (\gamma)$$

From (α) we see that T varies as e^2, that is, the torque is proportional to the square of the induction through the rotor. It is very important, therefore, that the induction density should be large, and, consequently, that the reluctance of the magnetic circuit should be small. To ensure this modern induction motors are constructed with as little clearance as possible between rotor and stator, and the coils of both stator and rotor are embedded in the iron, being at the same time as close as possible to the periphery. By this means the reluctance is reduced as much as possible, and the power of the motor correspondingly increased. The iron itself is laminated as in an ordinary stationary transformer, for, although in the induction motor, eddy currents are not useless in the production of torque, they are not confined to that direction which produces the maximum effect ; it is therefore advisable to reduce them as much as possible, and confine currents to properly disposed conductors. The modern rotor with short circuited coils is depicted in fig. 26.

The noticeable feature of induction motors is their simplicity of structure combined with great mechanical strength. The absence of commutators is an immense advantage, since there is no sparking limit to the output, as in direct current motors ; the consequence is that the output per unit weight is much greater in an induction motor than in a direct current machine. It is not difficult to construct induction motors of a moderate size, which attain the figure of 60 or 70 lbs. per horse-power, and this without any sacrifice of efficiency. The weight per horse-power is always less than in direct current motors of the same output.

Unless considerably overloaded, an induction motor will run quite cool compared with direct current motors of the same weight and output. This is due to the large cross-section which can be given to the conductors and to the fact that the winding is so arranged that the copper losses are not localised, while the laminated character of the iron facilitates ventilation.

Although we term induction motors *non-synchronous*, it should be borne in mind that there is always a tendency to synchronise. The speed of an induction motor is, in fact, almost independent of the load, and in this respect they are similar to a good shunt motor. The variation in speed from no load to full load seldom exceeds 5 per cent.

Another advantage possessed by induction motors is their high efficiency. Brake tests on standard Oerlikon three-phase motors show that their efficiencies vary from 55 per cent. for $\frac{1}{4}$ H.P. to 90 per cent. for 18 H.P., whilst an efficiency of 93 or 94 per cent. can be reached in a 100 H.P. motor.

It is usual to make large machines multipolar in order to reduce peripheral velocity of the rotor. Small machines can safely run at 2,000 revolutions, or more, per minute, and so can be made bi-polar. The speed of the rotor, for a given frequency in the stator currents, varies inversely as the number of poles, so that large machines are necessarily of the multipolar type.

ALTERNATE CURRENT TRANSFORMERS.

By Dr. J. A. FLEMING, F.R.S.

Society of Arts Cantor Lectures. Lecture I., delivered January 20th, 1896.

(*Continued from page* 93.)

Generally speaking, in a machine like the Mordey alternator with a very small armature reaction, there is very little change in the form of the electromotive force curve with the nature and amount of the load on the alternator, but in the case of a machine like the Thomson-Houston or Westinghouse alternator with a large armature reaction there is a very considerable change in the form of the electromotive force curve which changes in the amount and nature of the load. In the above cases the form of the electromotive force curves have been set out graphically in what are called wave diagrams, in which the horizontal ordinates represent time, and the vertical ordinates represent the magnitude of the quantity which is varying, whether electromotive force or current. For some purposes, this method is not so convenient as that of setting out the curves in the form of polar diagrams.

The differences between these two methods—graphically delineated a periodic quantity—are shown in figs. 16 and 17. In fig. 16, part of

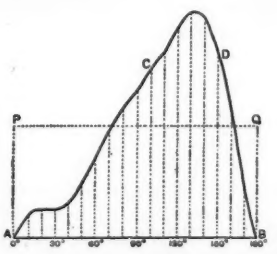


Fig. 16.

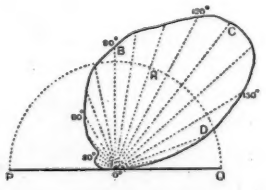


Fig. 17.

the curve of the electromotive force of a Thomson-Houston alternator on an inductive load is shown. In fig. 17 the same quantity is delineated in a polar curve. Instead of drawing vertical ordinates at equal distances to represent the instantaneous values of electromotive force, radii are drawn from a point, O, at equal angular intervals, the magnitudes of which are respectively proportional to the instantaneous values of the periodic quantity. A curve, B, C, D, is thus obtained, which is called a polar curve. It has this interesting property, that if we find the area of the polar curve, and describe a semicircle on a line, P, Q, passing through the pole, O, the area of which is equal to the area included by the polar curve, B, C, D, it can easily be shown that the radius of this semicircle represents the square root of the mean of the squares of all the radii of the polar curve. This quantity is now generally called the R.M.S. value, or the root-mean-square value of the periodic quantity. By some writers it has been called the effective or virtual value. Ordinary alternating current ammeters and voltmeters give, as is well known, the R.M.S. value of the periodic quantity they are measuring.

Returning to fig. 16, if we construct a rectangle, A, P, Q, B, equal in area to the area included by the wave curve, A, C, D, B, then it is easily seen that the height of this rectangle, namely, A, P, represents the true mean value of the periodic quantity represented by the ordinates of the wave curve. In the case of any periodic quantity, such as a periodic electromotive force or current graphically delineated it is found convenient to have a term to denote the ratio between the true

mean value of the curve ordinate and the root-mean-square value, and this is called the *form factor* of the curve.* Having thus seen the manner in which we can experimentally determine the form of an electromotive force or current curve, which represents the different instantaneous values of a periodic electromotive force or current, we can now proceed to discuss the manner in which these methods have been applied in the study of the alternate current transformer. Let us first suppose that the transformer to be studied is a constant potential transformer, having two windings, a primary and a secondary coil, both wound round an iron core forming a completely closed iron magnetic circuit. Let the primary coil be joined up through a non-inductive resistance, R¹, as shown in fig. 2, with a circuit of constant potentials, and let the contact breaker above described, denoted by C, and the electrostatic voltmeter, V, be applied to determine the form of the current curve flowing into the primary coil, P, of the transformer. In order to delineate the form of the curve of primary potential difference, it is necessary to put across the primary terminals of the transformer a non-inductive resistance, R², which is divided in a definite ratio, so that by measuring a fraction, say, $\frac{1}{20}$th of the whole difference of potentials between the terminals of the primary circuit of the transformer, we can determine the total potential difference. After much experimenting, I succeeded in devising a form of resistance which is now before you, and which is very convenient for this purpose. It is called a resistance cage. It consists, as you see, of a series of brass rods held in a wooden frame, each rod carrying a pair of porcelain heads, with porcelain pins on them (see fig. 18), and these porcelain heads are kept pressed apart by a spring. Over the pins on these porcelain heads is wound, in zig-zag fashion, a platinoid wire, so as to form a perfectly ventilated non-inductive resistance. Each of these resistances is adapted for withstanding 100 volts pressure, and carrying ½ or 1 ampere, and a series of 20 of these resistances can be put across the primary terminals of a transformer, and will withstand the pressure of 100 volts for as long as necessary. By measuring the full of potential and delineating the periodic value of the difference of potential between the terminals of one cage, which forms one of a series of 20, we can delineate the whole difference of potential between the terminals of a transformer. In this way we can take curves of primary current and primary electromotive force on the high tension side of a transformer. In the next place we can perform the same operation on the secondary side of the transformer, and obtain the secondary terminal potential difference curve, and also, if the transformer is sending a secondary current, the secondary current curve for that transformer. When these experiments are carried out for any good closed circuit transformer, and delineated in the form of a series of curves set in their proper relative position, which it is convenient to call a transformer diagram, we find the following results:—In the first place, the curve of secondary potential difference is always an exact copy to a reduced scale of the curve of primary potential difference, and it is very nearly exactly in opposition to it in phase. This is shown in fig. 19 and fig. 20. Fig. 19 gives us the curves of primary and secondary electromotive force of a Thomson-Houston transformer taken off a Mordey alternator. If the transformer is taken at no load, and if the curves of primary and secondary electromotive force are drawn to such scale as to their maximum ordinates equal to one another, and if they are drawn on the same side of the axis, then it is found that at no load the transformer curves exactly overlap one another. If the transformer is partly or wholly loaded up on its secondary side, so as to cause it to send a secondary current, then the secondary electromotive force is a little advanced in phase over the curve of primary electromotive force, as shown in fig. 18. Fig. 20 shows the same thing for the same transformer taken off a Thomson-Houston alternator. Hence we see that the closed circuit transformer acts like an electrical pantograph: it copies electrical potential difference, and the curve of secondary potential difference is always a nearly exact copy of the curve of primary potential difference; but to a reduced scale depending on what is called the transformation ratio of the transformer. On delineating the curve of primary current of the transformer when the transformer is taken at no load, as shown in fig. 21, we see that the curve of primary current, when the secondary circuit is open, differs in phase from the curve of primary potential difference. It lags behind it, and the same thing is shown by reference to fig. 14, where the curve of primary electromotive force for another transformer taken off the same alternator is given. It will be seen that even if the same alternator is employed for the test, the curve of primary current at no load is not the same in form in the case of all transformers. The form of this primary current curve is governed by the nature of the iron employed in the core. We then notice that even in cases where the primary electromotive force curve is more or less approximately a sine curve or simple periodic curve, the curve of primary current is always more irregular. Having in this manner delineated the curves of primary current, primary electromotive force and secondary current, we have then to determine the manner in which the induction in the core is varying with relation to these other varying quantities. We can draw out a curve of induction from the curve of a secondary electromotive force in the following manner.

Since the secondary electromotive force of the transformer at any instant is measured by the rate at which the magnetic induction linked with the secondary circuit is varying, we can construct the induction curve in the following way, as shown in fig. 22. The curve marked E.M.F. represents a transformer secondary electromotive force curve. The whole area of the curve is divided into two equal parts by a vertical line. Starting from this vertical line, half of the curve, say the right-hand half, is divided up into narrow strips of equal area, which are represented by the cross-hatched slips. The areas of these very narrow slips are then taken with the planimeter, and we set off, starting from the middle point of the time axis, the

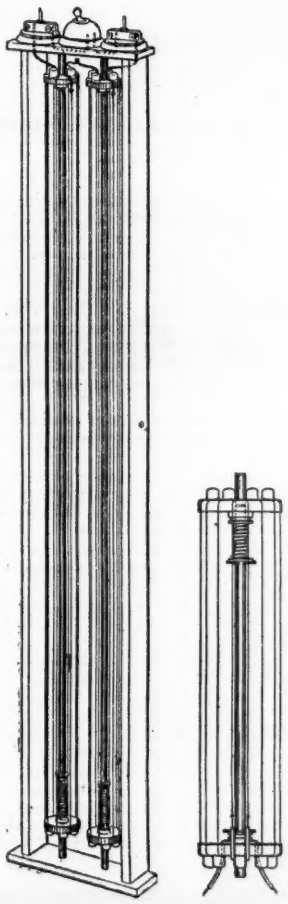


Fig. 18.—Non-Inductive Resistances.

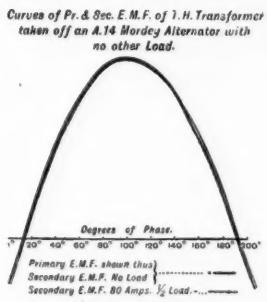

Curves of Pr. & Sec. E.M.F. of T.H. Transformer taken off an A.14 Mordey Alternator with no other Load.
Degrees of Phase.
Primary E.M.F. shown thus
Secondary E.M.F. No Load
Secondary E.M.F. 80 Amps. ½ Load.

Fig. 19.

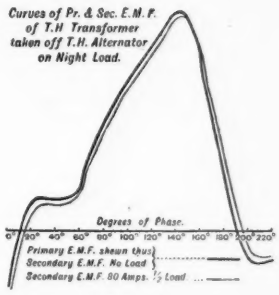

Curves of Pr. & Sec. E.M.F. of T.H Transformer taken off T.H. Alternator on Night Load.
Degrees of Phase.
Primary E.M.F. shown thus
Secondary E.M.F. No Load
Secondary E.M.F. 80 Amps. ½ Load

Fig. 20.

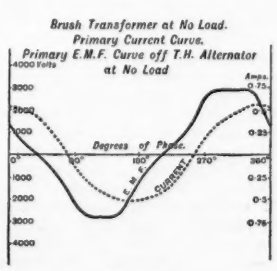


Fig. 21.

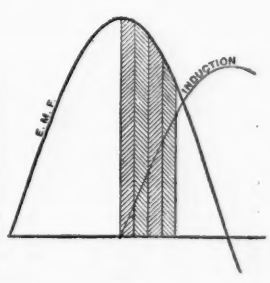


Fig. 22.

* For further information on this point see "The Alternate Current Transformer," Fleming, Vol. i. (new edition), page 583, published by The *Electrician* Printing and Publishing Company, 7, Salisbury Court, Fleet Street, E.C.

curve of induction by the following method. Starting from the middle point of the time line, we set off on the right-hand side of the first slip an ordinate, which represents to some suitable scale the area of slip No. 1. On the right hand bounding line of slip No. 2 we then set off an ordinate equal to the same scale of the total areas of slips No. 1 and 2 together. On the right hand bounding line of the third slip we then in the same way set off an ordinate representing the total area of the first three slips, and so on. In that way we obtain points on a curve which represents what is called the time integral of the electromotive force curve, and this is, therefore, the proper representation for the induction curve. In order to determine the scale to which this induction curve is drawn, we must know what is the value of the maximum ordinate of the induction curve. This can be done in the following manner:—If B represents the induction in the core, S the cross-section of the core, N_2 the number of turns of the secondary circuit, n the frequency of the alternating current, and f the form factor of the secondary circuit curve, then it can be shown that the root-mean-square value of the secondary electromotive force is equal to $4 f . n . N_2 S B$; and hence, since the root-mean-square value of the secondary electromotive force is immediately known from the delineated curve, and also its form factor, we can easily calculate the value of B, that is, of the induction.* That is to say, in this manner not only can we thus delineate the curves of current electromotive force, but also the induction, and represent them graphically on the same diagram. In fig. 23 are shown the curves of primary electromotive force, primary current, and induction for a Ganz transformer taken at no load. The curve of induction can be determined in the above-described manner, not only from the curve of secondary electromotive force, but also from the curve of primary electromotive force. If this is done, it is found that two curves of induction so obtained do not exactly coincide. The reason for this is the magnetic leakage of the transformer. This last term is best defined by saying that when the transformer is at work, and sending a secondary current, the whole of the magnetic induction which is linked with the primary circuit is not linked with the secondary circuit. There is, as it were, an escape of induction from the secondary circuit, which is called the magnetic leakage. In discussing in a later lecture the testing of a

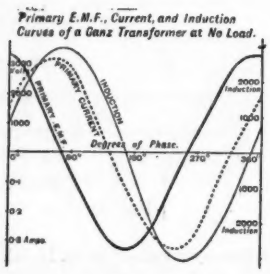


Fig. 23.

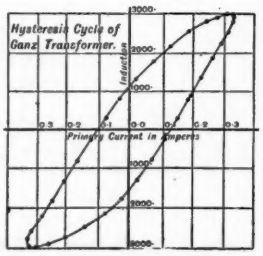


Fig. 24.

transformer, we shall consider how this quantity can be measured. Having delineated the whole of these curves for a transformer, we are then in a position to draw a hysteresis diagram for the transformer. To do this, we have to set off in the form of a cyclic curve the variation of induction with magnetising force. It can easily be shown that if we construct a closed curve, by setting off on a horizontal axis the different instantaneous values of the primary ampere-turns of a transformer on open secondary circuit taken at equal time intervals during the phase, and if corresponding with these we set off the vertical ordinates representing the total induction in webers in the core of the transformer corresponding to these different values of the ampere-turns, then the total area of that curve integrated in turns of a unit of area—one side of which represents a weber, and the other side of which represents an ampere-turn to the selected scale will give us the value in joules of the energy wasted in the core of the transformer in one complete magnetic cycle, and in this manner we can determine from the transformer diagram the power wasted in watts in the core when the transformer is on open secondary circuit. This power is spoken of as the iron core loss in the transformer, and it can be determined directly from the transformer diagrams. In a later lecture we shall see how it can be more conveniently determined by one single direct measurement with the wattmeter. The diagram in fig. 24 shows the hysteresis diagram thus determined for a Ganz transformer.

We have now briefly reviewed the chief actions going on in the transformer. Let us sum them up. If we apply to the terminals of a transformer a periodic electromotive force varying according to any law, we find that we have a periodic current set up in the primary circuit, which lags behind the primary electromotive force when the transformer is on open secondary circuit, but which gradually comes into step with it, in proportion as the transformer is loaded up. In good closed circuit transformers a very small amount of loading up—even as much as one-fiftieth of full load—will suffice to bring the primary current curve into step with the primary electromotive force curve. Secondly, we have a periodic magnetic induction in the core, which differs in phase, both from the primary current and the primary electromotive force, and it is found that this magnetic induction curve is always a more regular curve than the curve of primary electromotive force. When the curve of primary electromotive force is approximately a simple periodic curve, then the curve of induction is more nearly a simple sine curve. Thirdly, we have a curve of secondary electromotive force which is similar in form to, and exactly opposite in phase to, the curve of primary electromotive force when the transformer is on open secondary circuit, or when it is sending a small secondary current into a non-inductive resistance. If the secondary circuit of the transformer is practically non-inductive, as it is when the transformer is working upon a load of incandescent lamps, then the curve of secondary current is always in step with the curve of secondary electromotive force, and can be deduced from it. Lastly, we have a curve deduced from the curve of induction and primary current of no load, which give us the hysteresis curve of the transformer. The curve of primary current of no load is generally spoken of as the magnetising current, and the total power taken up in the iron core in watts is spoken of as the iron loss of the transformer.

* See "The Alternate Current Transformer," Vol. i., (new edition), p. 358.

THE VELVO-CARBON PRIMARY BATTERY.*

By G. C. ALLINGHAM, Student.

The battery I am about to describe this evening is an improvement of the Smee cell, and is the invention of Mr. H. T. Barnett, M.I.E.E. Its chief novelty lies in the negative electrode. This consists of carbon rods, which have strips of velvet wound round them, and stuck to them with ordinary flour-paste. They are then embedded in powdered charcoal in muffles, and heated to a white heat in a regenerated coke furnace to carbonise the velvet. A little of the charcoal sticks to the carbonised velvet, and when the electrodes are immersed in the acid for the first time, it comes off, and may be seen floating about in the acid. It does not seem to have much action on the zincs. After that, there is no disintegration of the carbonised velvet.

Carbon rods are thus obtained covered with a number of projecting carbon filaments, which greatly facilitate the escape of the hydrogen given off at the cathode. These "velvo-carbon" electrodes, as they are called, work very well in bichromate or other depolarising solutions, but it is simpler, and also more economical, to use simply dilute sulphuric acid, in spite of the lower E.M.F. obtained, and correspondingly heavier consumption of zinc per watt-hour. For in a cell of the Bunsen or two-fluid bichromate type, the cost of the depolariser is about three-fourths of the whole cost of recharging, the other fourth being for zinc and dilute sulphuric acid. Again, although the E.M.F. of a Bunsen is given as 1·8 volt, and that of a bichromate as 2 volts, it should be borne in mind that this is the E.M.F. *on open circuit*, and when freshly charged; the internal resistance of these two fluid cells is comparatively high, and their E.M.F. falls off somewhat owing to so-called "polarisation," so that the actual P.D. on the terminals obtained while giving current is seldom more than 1—1¼ volt. Now the P.D. of a velvo-carbon cell is ·5 to ·6 volt, so that often two, or at most three V.C. cells will replace one Bunsen or bichromate, so that although we pay twice as much for zinc, we pay nothing for depolariser, and so the total cost of recharging comes out not much more than half that of working a Bunsen.

The zinc in a velvo-carbon battery gives over 300 ampere hours per pound (the theoretical yield is about 370 ampere hours), and nearly 2 lbs. of acid are consumed for each pound of zinc. Now at a P.D.

Fig. 1.

of ·55 volt, 1 kilowatt-hour corresponds to 1,800 ampere hours, which will require less than 6 lbs. of zinc, and 12 lbs of acid. The retail price of zinc is 4d. per pound, and it will cost about 1d. per pound to amalgamate, and the retail price of sulphuric acid is about 1d. per pound. The cost of a Board of Trade unit is therefore under 3s. 6d., and on a large scale it would only be about half this.

I have not considered the single fluid bichromate cell, as in it the local action is very violent, and it is therefore very uneconomical, and gives an unsteady current. That the current from the velvo-

* Paper read before a student's meeting of the Institution of Electrical Engineers on Wednesday, December 4th, 1895; since rewritten for the Electrical Review.

carbon battery is steady, you can see from the diagram I have prepared (figs. 1, 2) from a test made by Mr. Barnett, of a cell designed for electric launch work. When the electrodes are first immersed in the acid, and before they are polarised, the E.M.F. is high, but it falls rapidly, and after from 5 to 15 minutes, the carbons are quite polarised by the hydrogen, and the current becomes very constant. For this reason the electrodes should be lowered gradually at first in cases where the sudden rush of current is likely to be injurious, as for electric lighting. After this, the current cannot become weaker through polarisation, because the battery is fully polarised all the time, and the current is very steady until the acid is nearly all used up, and the internal resistance increases considerably, when, of course, the cell is recharged.

There is another cell which rivals the velvo-carbon, and that is the Lalande copper oxide cell. This also gives a steady current at about the same P.D. as the V.C., but it consumes caustic potash instead of acid, which is, of course, much cheaper. It also consumes copper oxide; this can be regenerated by roasting, but gives a good deal of trouble, so most people throw their copper away, or sell it for old metal, and buy new oxide. Moreover, in the latest form, the Edison-Lalande cell, copper oxide slabs are used, which tend to disintegrate on roasting. The Lalande cell has the advantage that the zincs may be left in the liquid for long periods, as the local action is so small. When the velvo-carbon battery is charged with acid of 25 per cent. strength, or 1·180 sp. gr., as is usual for generating heavy currents, the zincs should be removed when not in use. When less current is required, weaker acid may be used, and the zincs may be left in the liquid for many weeks without much local action, if they are well amalgamated. For cells of this kind, Mr. Barnett uses a porcelain arrangement shaped like an inverted mushroom, which has mercury

P.D. at terminals.

FIG. 2.

placed at the bottom, and is filled with granulated zinc. Contact is made to the mercury with a copper wire. The zinc is thus always saturated with mercury, and, besides, all the zinc is dissolved, which is not the case with plates. Where the zinc has to be left in the electrolyte for months or years, as in what are known as "open-circuit batteries," the Leclanché is nearly always found to be the most suitable battery, though the velvo-carbon will work with caustic potash solution, when only weak currents are required. For every other purpose, I believe the velvo-carbon to be the best primary battery we have, for not only is it the most economical, but also one of the simplest to manipulate. Any of you who have used two-fluid cells will know what a nuisance they are.

Again, it is not generally found economical to produce electricity by dynamos where less than 1 H.P. is needed, for below that power engines are mere toys; they are very inefficient, and always getting out of order, and the cost of repairs is excessive. Thus, although

FIG. 3.

it is expensive, when a small amount of electricity (say, not more than 100 or 200 watts) is needed, a primary battery is about the only means of producing it. Of course, everybody knows that a zinc-consuming battery is hopelessly out of the running for powers of more than about 1 H.P., except under very exceptional circumstances. In many cases it is superior to accumulators, over which it has the advantages that it is not nearly so likely to get out of order, and therefore does not require such care and attention, and it is not injured by vibration, washing of the acid, short circuiting, over-discharging, or standing idle for long periods, and it is, besides, less troublesome to discharge. For instance, the battery has been successfully used for driving electric launches; it really is hardly, if at all, more expensive to run a launch on the Thames with primary than with secondary batteries, as the cost of having the latter recharged at a central station is high (about 10s. a time, I believe), and, of course, in most places there are no charging stations. Again, when a low voltage current is required for experimental purposes (*e.g.*, for charging portable accumulators), it is often obtained by putting resistance into an electric light circuit. This plan is often a good deal more expensive than using V.C. cells; thus, if current for which we paid 6d. per unit were laid in at 100 volts, and we wanted current at, say, 6 volts, we should have to pay 8s. 4d. per unit for it.

On the other hand, the velvo-carbon battery shares with every other primary battery with which I am acquainted the disadvantage of bad regulation; that is to say, if the current is altered, the P.D. alters, owing to the internal resistance. This is not of much importance for power work, but I believe it will prevent primary batteries from ever being successfully used for direct lighting, except in the comparatively rare cases where all the lights are turned on and off together. For lighting, I think it will usually be found advisable to instal accumulators, to be charged by the primary battery. In most cases, when V.C. cells are used to charge accumulators, their rate of discharge can be reduced, and their P.D., therefore, increased, so that the voltage obtainable from the storage cells is as high, or higher, than could be obtained direct from the primary battery. Thus the loss due to storage is, in part, compensated by the reduced drop of potential inside the primary cells themselves. Five V.C. cells will charge up a storage cell rapidly; four V.C. cells will charge at a moderate rate, and when the storage cell is only used intermittently, three V.C. cells are enough to keep it fully charged.

I will now describe more fully the construction of the velvo-carbon electrodes. It was found that the evolution of hydrogen at the carbons was greatly facilitated by platinising them; but if they were platinised in the usual way, *i.e*, by depositing platinum on them

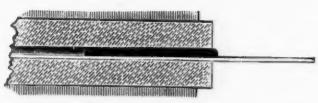


FIG. 4.

electrolytically from a solution of platinic chloride (or, more correctly, platinichloric acid), the platinum only adhered imperfectly, and soon came off, so platinic chloride solution is rubbed into the velvet before it is attached to the carbon; in carbonising, it is reduced to metallic platinum, which impregnates the carbon. The cost of doing this is stated to be only about ¼d. per rod. In carbonising, the velvet contracts; in the case of the rods, this only increases the grip of the velvet on the rod, but if it were attached to a large surface—such as a plate—before carbonising, the shrinkage would cause it to curl up and tear itself off; so when it is required to make electrodes of this kind, the velvet has to be carbonised first, then pasted on, and put in the furnace again to carbonise the paste and make a good joint. For this reason it is found cheaper to use carbon rods, which can easily be made up into electrodes of any desired size by mounting them side by side as "palisades" (fig. 3). Ordinary arc-light hollow carbons are used, but without the soft core. Various kinds of velvet were tried, but a short pile cotton velvet has been found on the whole the

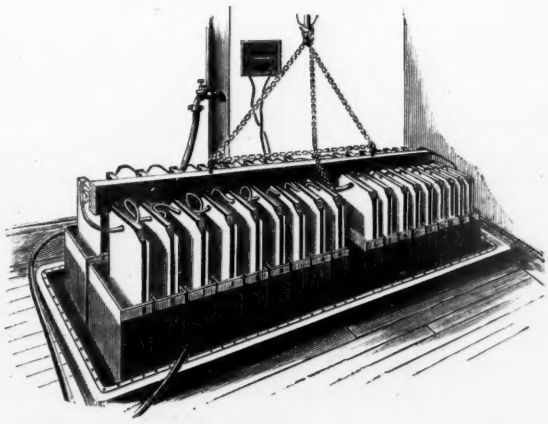


FIG. 5.

most satisfactory for ordinary work. The normal current obtainable is about ·5 ampere per foot of rod of 9 mm. diameter, and at this rate of discharge the P.D. is about ·5 volt.

The ends of the carbon rods are embedded in two wooden bars, saturated with ozokerit, which hold the carbons in position, and also serve as distance pieces to keep the zincs from touching them. This is, in my opinion, the weak point of the electrodes, for the carbons are only attached to the wooden bars which hold the electrodes together by the ozokerit, which is somewhat brittle, and easily broken by a shock of any kind. Mr. Barnett is now, however, making improvements in the electrodes, which I am not at liberty to describe. The connection to each carbon rod is made with a bit of silver wire about 1½ inch long, costing about ¼d., which is wedged into the hole in the carbon with a bit of ebonite rod, softened by heat (see fig. 4). On cooling,

the ebonite expands, and wedges the silver firmly against the carbon. The other ends of the wires are connected to "bus bars" of lead or silver. The connections have to be protected by wax against the "creeping" of the acid, otherwise the silver would be corroded by the combined action of the acid and the air.

The zinc electrodes are cut from 16 gauge sheet zinc. The reasons for making them so thin are that they may be sent out amalgamated, and never require re-amalgamation, and that for portable cells it is advantageous to reduce the weight as far as possible. The stationary batteries are usually of the "plunge" type, with one palisade between two zincs in each cell. Fig. 5 is such a battery, capable of giving about 20 amperes at 18 volts for 40 hours.

In the traction cells, a number of palisades are placed side by side like the plates of an accumulator, with a zinc between each pair, and they are all held in position by a couple of wedges at one end of the cell, which at the same time press the zincs against contacts connected to the palisades in the next cell. On removing these wedges, the electrodes are all freed, and may be removed together or separately.

The velvo-carbon battery is, after all, only an improved form of Smee, but the first cost of the Smee cell is very high, and the platinised silver plates are injured by mercury, and have to be replatinised occasionally, while it is claimed that velvo-carbon electrodes never need replatinising. In cells of the Smee type there is always a tendency, after a very long run, for mercury, which has been dissolved from the amalgamated zinc plate, to be deposited on the negative electrode. This would ruin a platinised silver plate, but on a velvo-carbon electrode it merely produces a "mercury polarisation," and a short exposure to the air will oxidise the mercury, which will be dissolved on again immersing the electrodes.

The carbonised velvet will not bear much handling, as the slender carbon filaments are very fragile, but the carbon rods are so mounted as to protect it as far as possible, and with reasonable care it will not get rubbed off.

In conclusion, I have to express my best thanks to Mr. Barnett and the Battery and Motor Company for giving me every information as to the manufacture of the battery. This battery, unlike most of those that have been brought out recently, has no secret solution or special alloy for anode; there is no "hanky-panky" (if the expression may be permitted) of any kind about it. Nothing is consumed in it but ordinary zinc and ordinary sulphuric acid.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn*, *London*, *W.C.*, *to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

14,946. "Improvements in insulating electric conductors." W. S. Smith and W. P. Granville. Dated July 6th.

14,996. "Improvements in and connected with automatic or thermostatic fire alarm telegraph systems." W. E. Heys. (J. W. Frost, United States.) Dated July 7th. (*Complete.*)

15,013. "Improvements in electrical selectors and answer-backs." T. McKenna. (J. M. Drysdale, United States.) Dated July 7th. (*Complete.*)

15,031. "Improvements in dynamo-electric machines and methods of compounding the same." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated July 7th. (*Complete.*)

15,074. "Improvements in or relating to electrically ignited torches, cigar lighters, or the like." J. Hencken and J. H. Meyer. Dated July 7th. (*Complete.*)

15,078. "Method of and means for recording in connection with electricity supply." A. M. Billington. Dated July 7th.

15,102. "Improvements in the method of winding armatures for multipolar continuous current dynamo electric machines and electric motors." F. H. Royce and E. A. Claremont. Dated July 8th. (*Complete.*)

15,129. "A process and apparatus for effecting electrolysis." F. W. Golby. (O. Arlt, Germany.) Dated July 8th. (*Complete.*)

15,162. "Improvements in electric meters." Siemens Bros. & Co., Limited. (Siemens & Halske, Germany.) Dated July 8th.

15,176. "Improvements in or connected with dynamo electric machines for use in what is known as the three-wire system." J. Y. Johnson. (The Electricitats actien Gesellschaft vormals, W. Lahmeyer & Co., Germany.) Dated July 8th.

15,223. "Improvements in or relating to the production of electricity." H. F. Kirkpatrick-Picard. Dated July 9th.

15,292. "Improvements in arc lamps." A. T. Schmidt and F. T. Schmidt. Dated July 10th.

15,303. "Improvements in the method of and means for protecting electric lamp fittings from damp and corrosion, and for preventing short-circuiting." J. L. Kendal. Dated July 10th.

15,318. "Improvements in apparatus for the ignition of hydrocarbon and other gases by electricity." M. Byng and L. D. Cole. Dated July 10th.

15,321. "Automatic switch for sending the current always in the same direction through the whole or some part of the circuit, independent of the current in the mains." W. Booth. Dated July 10th.

15,322. "Converter for changing continuous into alternating current to be used in connection with transformers." W. Booth. Dated July 10th.

15,326. "Improvements in insulating and supporting electric wires intended to act as electrical resistances applicable as radiators of heat for cooking, warming, and other purposes." R. E. B. Crompton and E. J. Fox. Dated July 10th.

15,380. "Improvements in the means of connecting branch electric light wires to the main or line wires." S. Scargill and A. Hanson. Dated July 11th.

15,443. "An improved preparation of electrolyte for use in semi-dry primary or secondary electric batteries." H. Weymersch and A. McKenzie Cardwell. Dated July 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price*, *post free*, 8½*d.* (*in stamps.*)]

1895.

7,910. "Improvements in and connected with apparatus for lighting up roundabouts and the like by electricity." F. J. Borland. Dated April 20th, 1895. Relates to the combination with "cheese" wheel of a roundabout, of tape or bands engaging with the wheels or runners, that the said wheels cannot slip off the tapes or bands when in action. Various other improvements are described. 6 claims.

7,191. "Improvements in electric arc lamps." H. J. Fisher. Dated April 8th, 1895. Comprises the combination of a hot wire shunt device of high resistance mounted upon and moving with a rocking frame carrying the feed mechanism and adapted to operate automatically a brake controlling same, with a hot wire device of low resistance in series with the carbons, and adapted to control the position of the said rocking frame and to strike the arc. 3 claims.

8,764. "Improvements in distribution of electricity." A. Wright. Dated November 3rd, 1895. These improvements consist in supplying a single network during the period of light or comparatively light load with low tension alternating currents fed direct from low tension feeders, and during the period of heavy load supplementing this supply with low tension alternating currents from transformers fed by high tension feeders. 3 claims.

8,876. "Improvements in or connected with electric batteries." C. Q. Shrewsbury, F. L. Marshall, J. Cooper, and J. N. Dobell. Dated May 4th, 1895. Relates to class of battery where the exciting fluid is a fused salt and dissolving electrode carbonaceous material, and consists in the combination of a cell or series of cells containing suitable electrodes, a circulation pipe connecting the extremity, and injector located within the circulation pipe. A vapourising chamber immersed in the fused salt, and directly connected with the injector without the intervention of a secondary chamber, and with a supply of nitric acid or the like. 3 claims.

10,313. "Improvements in effecting telegraphic or telephonic communication through submerged cables, and in the construction of cables to be used for the purpose." W. S. Smith and W. P. Granville. Dated May 24th, 1895. In the case of rapid transmission on a cable, the return circuit, *i.e.*, the water in which the cable is submerged, offers an increasing resistance (the sectional area traversed by the circuit becoming less and less) in proportion as the rapidity of transmission increases. To obviate this cables are constructed with a sheath of uninsulated copper or other conductive metal enveloping the cable. 2 claims.

20,801. "An improved means for electrically lighting gas jets from a distance." O. von Morstein. Dated November 4th, 1895. Describes a device for lighting gas jets from a distance by means of secondary induction circuits, in which device the contact mechanism automatically produces a continuously interrupted close circuit during such length of time as is required from the ignition of gas. 2 claims.